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(54) **CLOSED STOPCOCK**

ABSPERRHAHN

ROBINET D'ARRÊT

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EP 4 032 568 B1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to stopcocks generally, and more specifically to swabbable stopcocks.

BACKGROUND OF THE INVENTION

[0002] Various fluid flow regulators, such as stopcocks, are known in the art. Closed stopcocks typically have a luer activated valve incorporated within one of the stopcock ports for convenient engagement of a medical instrument with the stopcock.

[0003] DE 10 2015 205517 relates to a medical fluid control device for a medical fluid line system, and discloses a stopcock according to the pre-characterizing portion of appended independent claim 1. US9016316B2 discloses another example of stopcock.

SUMMARY OF THE INVENTION

[0004] In accordance with the present invention, there is provided a stopcock as defined in appended independent claim 1. Embodiments of the present invention are defined in appended claims dependent on independent claim 1.

[0005] The present invention seeks to provide an improved closed stopcock.

[0006] In accordance with an embodiment of the present invention, a stopcock comprising a housing element defining a central bore and at least first, second and third ports, and a handle element, which is selectably positionable relative to the housing element, the housing element and the handle element being arrangeable in multiple mutual positions, at least one of the housing element and the handle element defining a first fluid flow passageway communicating between two of said at least first, second and third ports, and a second fluid flow passageway communicating between at least two of the at least first, second and third ports, selection of the ports being in accordance with a relative position of the handle element relative to the housing element; the first fluid flow passageway including a side-to-side extending bore extending through the handle, and the second fluid flow passageway including a fluid flow guide, and a second fluid flow guide extending radially and partially bifurcating one of the at least one of the first, second and third ports, the second fluid flow guide being associated with at least one of the first fluid flow passageway and the second fluid flow passageway, characterized in that said first fluid flow passageway is fluidly isolated from said second fluid flow passageway in at least one of said mutual positions.

[0007] Preferably, the fluid flow guide extends radially towards an inner facing wall of the central bore and partially bifurcates the second fluid flow passageway. Further preferably, the first fluid flow passageway and the second fluid flow passageway are operative simultaneously in at least one of the multiple mutual positions.

[0008] Yet further preferably, the second fluid flow passageway being configured for enabling flushing an internal volume of at least one of the first, second and third ports by a fluid flow which does not flow entirely through the port whose internal volume is being flushed, and the first fluid flow passageway being configured for increasing a fluid flow rate between two of the at least first, second and third ports.

[0009] In accordance with an embodiment of the present invention, the fluid flow guide comprising an outward facing edge which sealingly engages an inner facing wall of the central bore, and when the outward facing edge of the fluid flow guide is not located opposite any of the first, second and third ports, flow of liquid through the second fluid flow passageway is prevented and flow of liquid through the first fluid flow passageway is allowed.

[0010] In accordance with an embodiment of the present invention, the stopcock also comprising at least one valve, which is associated with at least one of the first, second and third ports. Preferably, the valve includes an elastomeric element, and wherein at least one of the first fluid flow passageway and the second fluid flow passageway is configured for providing a fluid flow which is sealed from the elastomeric element when the housing element and the handle element are in another one of the mutual positions.

[0011] Further preferably, both the first fluid flow passageway and the second fluid flow passageway are defined by a shaft portion of the handle element. Still further preferably, the at least one side-to-side extending bore has a semi-circular cross-section. Yet further preferably, the handle element has a partially peripherally-extending recess, selectably defining the second fluid flow passageway, the fluid flow guide extending radially and partially bifurcating the recess.

[0012] In accordance with an embodiment of the present invention, the at least one side-to-side extending bore is spaced from the recess.

[0013] Preferably, the fluid flow rate is increased by at least 25%.

[0014] Preferably, the first fluid flow passageway is fluidly connected with the second fluid flow passageway in other of said at least one of the mutual positions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

Fig. 1 is a simplified exploded view illustration of a stopcock constructed and operative in accordance with an embodiment not forming part of the present invention:

Figs. 2A & 2B are simplified pictorial illustrations of a housing element, which forms part of the stopcock of Fig. 1 taken in two different directions;

Figs. 3A & 3B are sectional illustrations taken along

section lines A - A and B - B in Figs. 2A and 2B, respectively;

Figs. 4A & 4B are simplified pictorial illustrations of a handle element, which forms part of the stopcock of Fig. 1 taken in two orientations;

Figs. 5A & 5B are simplified plan view illustrations of the handle element of Figs. 4A & 4B taken along respective directions A and B in Fig. 4A;

Figs. 6A, 6B and 6C are sectional illustrations taken along section lines A - A, B - B and C - C in Fig. 4B;

Fig. 7 is a simplified exploded view illustration of a stopcock constructed and operative in accordance with another embodiment not forming part of the present invention;

Figs. 8A & 8B are simplified pictorial illustrations of a handle element, which forms part of the stopcock of Fig. 7 taken in two orientations;

Figs. 9A & 9B are simplified plan view illustrations of the handle element of Figs. 8A & 8B taken along respective directions A and B in Fig. 8A;

Figs. 10A, 10B and 10C are sectional illustrations taken along section lines A - A, B - B and C - C in Fig. 8B;

Fig. 11 is a simplified exploded view illustration of a stopcock constructed and operative in accordance with still another embodiment not forming part of the present invention;

Figs. 12A & 12B are simplified pictorial illustrations of a handle element, which forms part of the stopcock of Fig. 11 taken in two orientations;

Figs. 13A & 13B are simplified plan view illustrations of the handle element of Figs. 12A & 12B taken along respective directions A and B in Fig. 12A;

Figs. 14A, 14B and 14C are sectional illustrations taken along section lines A - A, B - B and C - C in Fig. 12B;

Fig. 15 is a simplified exploded view illustration of a stopcock constructed and operative in accordance with an embodiment of the present invention;

Figs. 16A & 16B are simplified pictorial illustrations of a handle element, which forms part of the stopcock of Fig. 15 taken in two orientations;

Figs. 17A & 17B are simplified plan view illustrations of the handle element of Figs. 16A & 16B taken along respective directions A and B in Fig. 16A;

Figs. 18A, 18B and 18C are sectional illustrations taken along section lines A - A, B - B and C - C in Fig. 16B;

Figs. 19A, 19B, 19C and 19D are simplified assembled pictorial illustrations of the stopcock of Fig. 1 in four operative orientations;

Figs. 20A, 20B, 20C and 20D are sectional illustrations of a stopcock having the handle shown in Figs. 4A - 6C, taken along section lines A - A, B - B, C - C and D - D in Figs. 19A, 19B, 19C and 19D respectively;

Figs. 21A, 21B, 21C and 21D are sectional illustrations of a stopcock having the handle shown in Figs. 8A - 10C, taken along section lines A - A, B-B, C - C and D - D in Figs. 19A, 19B, 19C and 19D respectively;

Figs. 22A, 22B, 22C and 22D are sectional illustrations of a stopcock having the handle shown in Figs. 12A - 14C, taken along section lines A - A, B-B, C - C and D - D in Figs. 19A, 19B, 19C and 19D respectively;

Figs. 23A, 23B, 23C and 23D are sectional illustrations of a stopcock having the handle shown in Figs. 16A - 18C, taken along section lines A - A, B - B, C - C and D - D in Figs. 19A, 19B, 19C and 19D respectively.

DETAILED DESCRIPTION OF THE EMBODIMENTS OF INVENTION

[0016] Reference is now made to Fig. 1, which is a simplified exploded view illustration of a stopcock constructed and operative in accordance with an embodiment not forming part of the present invention;

[0017] As seen in Fig. 1, the stopcock comprises a housing element 100 including a main tubular portion 102 and three side ports, designated by reference numerals 104, 106 and 108 respectively. A handle element 110 is arranged to be seated within main tubular portion 102 of housing element 100.

[0018] Reference is now made additionally to Figs. 2A & 2B, which are simplified pictorial illustrations of the housing element 100 and to Figs. 3A & 3B, which are sectional illustrations thereof.

[0019] As seen in Figs. 1 - 3B, tubular portion 102 of housing element 100 is generally cylindrical, arranged about an axis 112, and has side ports 104, 106 and 108 extending in different directions therefrom, typically separated by 90 degrees about axis 112. First port 104 is preferably a male port which preferably meets luer standard ISO 594-1, while second port 106 is configured for incorporating a normally closed swabbable valve which is configured to receive a male luer and third port 108 is preferably a female port, which preferably meets luer standard ISO 594-1. Conventional plugs, nuts and covers may be used in association with ports 104 and 108.

[0020] Port 106 of housing element 100 preferably includes a valve employing an elastomeric element 114, held in place by a cap 116, which is welded or otherwise fixed to housing element 100. Elastomeric element 114 and cap 116 are commercially available from Halkey-Roberts Corporation of St. Petersburg, Fla., USA and described in one or more of U.S. Pat. Nos. 6,651,956; 6,089,541 and 6,036,171. Alternatively, valves and valve elements commercially available from other sources such as Becton-Dickinson, Cardinal, Medegen and Filtertek may be employed.

[0021] Ports 104 and 108 are preferably arranged along a mutual longitudinal axis 117 and port 106 is preferably arranged along axis 118, which extends generally perpendicularly to axis 117.

[0022] Tubular portion 102 includes a central bore 119 having a slightly conical configuration, which is formed with a circumferential undercut 120. Port 106 defines an interior volume 121, which includes a generally cylindrical bore 122 of a first diameter, adjacent to and extending from central bore 119 and a valve accommodating bore 124 of a second diameter, which is preferably greater than the first diameter, extending generally outwardly of cylindrical bore 122. Cylindrical bore 122 defines a first volume 126 and valve accommodating bore 124 defines a second volume 127. It is noted that elastomeric element 114 is adapted to be fixedly seated between cap 116 and port 106, a portion of the elastomeric element 114 is adapted to be seated within second volume 127 of port 106.

[0023] A fluid flow guide 128 preferably bifurcates cylindrical bore 122 of port 106, and extends between the central bore 119 and the elastomeric element 114.

[0024] Reference is now made to 4A - 5B, which are simplified pictorial illustrations of the handle element 110 forming part of the stopcock of Fig. 1, and to Figs. 6A - 6C, which are sectional illustrations thereof.

[0025] As seen in Figs. 4A - 6C, the handle element 110 includes a shaft portion 130, which is integrally formed with a top portion 132 from which extends a finger-engageable protrusion 134. It is appreciated that any other suitable general configuration of the top portion of the handle element may alternatively be employed.

[0026] Shaft portion 130 is generally symmetrical about a shaft axis 142 and has a slightly conical outer surface 144, typically having an angle α (as seen particularly in Fig. 5A) of 3-4 degrees, which corresponds to the slightly conical configuration of central bore 119 for rotatable sealing engagement therewith. As seen particularly in Fig. 6C, shaft portion 130 is typically formed with mutually sealed top and bottom cylindrical recesses 146 and 148, which are sealingly separated by a divider 150.

[0027] At least one fluid flow passage is provided through handle element 110.

[0028] It is a particular feature of an embodiment that preferably two fluid flow passages are provided through handle element 110. This enables an increase of a fluid flow rate through the handle element 110. In accordance with an embodiment of the present invention, the fluid flow rate is increased by at least 25%. In accordance with another embodiment the fluid flow rate is increased by at least 50%. For example, in a particular embodiment the fluid flow rate is increased from 300ml/min to 600ml/min.

[0029] It is a particular feature of an embodiment that the two fluid flow passages are interconnected in some of the mutual relative positions of the handle element 110 and the housing element 100 and that the two fluid flow passages are isolated in other of the mutual relative positions of the handle element 110 and the housing element 100 as described in detail hereinbelow.

[0030] Disposed generally between recesses 146 and 148 and sealed therefrom is a side-to-side extending bore 152, selectably defining a first fluid flow passageway between two of the selectable ones of side ports 104, 106 and 108 depending on the rotational orientation of the handle element 110 relative to the housing element 100. It is appreciated that in this particular embodiment, the side-to-side extending bore 152 has a semi-circular cross-section, however it is appreciated that bore 152 can alternatively have any other shape, such as circular, rectangular or other which provides the desired fluid flow rate.

[0031] Further disposed generally between recesses 146 and 148 and sealed therefrom is a partially peripherally-extending recess 153, selectably defining a second fluid flow passageway between selectable ones of side ports 104, 106 and 108 depending on the rotational orientation of the handle element 110 relative to the housing element 100. Preferably extending radially and partially bifurcating the recess 153 is a fluid flow guide 154, which is configured for directing the flow of liquid between any of ports 104 and 108 through the second fluid flow passageway defined by recess 153 into the internal volume 121 of port 106 for flushing thereof, when the handle element 110 is suitably positioned. The radially outward facing edge 156 of fluid flow guide 154 is formed with a suitably tapered configuration in order to prevent liquid flow there past when fluid flow guide 154 is not located opposite a port as described in detail hereinbelow. It is noted that, in other arrangements not forming part of the present invention, the fluid flow guide 154 may alternatively have any other suitable shape, such that the radially outward facing edge 156 thereof can extend towards the inner surface of central bore 119 but slightly spaced therefrom in order to provide minimal fluid flow passage there past when fluid flow guide 154 is not located opposite any of ports 104, 106 and 108.

[0032] It is a particular feature of an embodiment that fluid communication between opposite ends of bore 152 occurs in parallel to fluid communication along recess 153 at least in some of the mutual relative positions of the handle element 110 and the housing element 100.

[0033] Fluid flow guide 154 directs the flow of liquid between ports 104 and 108 through recess 153 and into the internal volume 121 of port 106 for flushing thereof, when the handle element 110 is suitably positioned. Simultaneously, fluid flow is directed between ports 104 and 108 through bore 152, thereby increasing the fluid flow rate through the stopcock of Fig. 1.

[0034] It is specifically seen in Fig. 6A that in accordance with an embodiment of the present invention, the fluid flow guide 154 is formed as a generally flat wall 160, which is adapted to extend up to the inner surface of the inner bore 119 of housing element 100 and a generally wider arcuate concave portion 162 formed on each side of the flat wall 160 and extending slightly outwardly therefrom. In this particular embodiment, the concave portion 162 of fluid flow guide 154 is located adjacent bore 152 and typically extends along a relatively minor longitudinal extent of bore 152.

[0035] Reference is now made to Fig. 7, which is a simplified exploded view illustration of a stopcock constructed and operative in accordance with another embodiment not forming part of the present invention.

[0036] As seen in Fig. 7, the stopcock comprises a housing element 100, which is preferably identical in all respects to housing element 100 which is illustrated and described with respect to Figs. 2A - 3B. The housing element 100 includes a main tubular portion 102 and three side ports, designated by reference numerals 104, 106 and 108 respectively. A handle element 210 in accordance with another embodiment is arranged to be seated within main tubular portion 102 of housing element 100. It is also noted that a similar elastomeric element 114 and cap 116 are adapted to be seated within port 106 of the housing element 100, in a similar manner as described with respect to Figs. 1 - 3B.

[0037] Reference is now made to Figs. 8A - 9B, which are simplified pictorial illustrations of the handle element 210 forming part of the stopcock of Fig. 7 and to Figs. 10A - 10C, which are sectional illustrations thereof.

[0038] Shaft portion 230 is generally symmetrical about a shaft axis 242 and has a slightly conical outer surface 244, typically having an angle α (as seen particularly in Fig. 9A) of 3-4 degrees, which corresponds to the slightly conical configuration of central bore 119 for rotatable sealing engagement therewith. As seen particularly in Fig. 10C, shaft portion 230 is typically formed with mutually sealed top and bottom cylindrical recesses 246 and 248, which are sealingly separated by a divider 250.

[0039] At least one fluid flow passage is provided through handle element 210.

[0040] It is a particular feature of an embodiment that preferably two fluid flow passages are provided through handle element 210. This enables an increase of a fluid flow rate through the handle element 210. In accordance with an embodiment, the fluid flow rate is increased by at least 25%. In accordance with another embodiment of the present invention the fluid flow rate is increased by at least 50%. For example, in a particular embodiment of the present invention the fluid flow rate is increased from 300ml/min to 600ml/min.

[0041] It is a particular feature of an embodiment that the two fluid flow passages are interconnected in some of the mutual relative positions of the handle element 210 and the housing element 100 and that the two fluid flow passages are isolated in other of the mutual relative positions of the handle element 210 and the housing element 100 as described in detail hereinbelow.

[0042] Disposed generally between recesses 246 and 248 and sealed therefrom is a side-to-side extending bore 252, selectably defining a first fluid flow passageway between two of the selectable ones of side ports 104, 106 and 108 depending on the rotational orientation of the handle element 210 relative to the housing element 100. It is appreciated that in this particular embodiment, the side-to-side extending bore 252 has a semi-circular cross-section, however it is appreciated that bore 252 can alternatively have any other shape, such as circular, rectangular or other which provides the desired fluid flow rate.

[0043] Further disposed generally between recesses 246 and 248 and sealed therefrom is a partially peripherally-extending recess 253, selectably defining a second fluid flow passageway between selectable ones of side ports 104, 106 and 108 depending on the rotational orientation of the handle element 210 relative to the housing element 100. Preferably extending radially and partially bifurcating the recess 253 is a fluid flow guide 254, which is configured for directing the flow of liquid between any of ports 104 and 108 through the second fluid flow passageway defined by recess 253 into the internal volume 121 of port 106 for flushing thereof, when the handle element 210 is suitably positioned.

[0044] In an arrangement not forming part of the present invention, the radially outward facing edge 256 of fluid flow guide 254 extends preferably towards the inner surface of central bore 119 but is slightly spaced therefrom in order to provide minimal fluid flow passage there past when fluid flow guide 254 is not located opposite a port as shown and described in detail hereinbelow. In other arrangements, the fluid flow guide 254 may alternatively have many other shapes such that the radially outward facing edge 256 of fluid flow guide 254 is formed with a suitably tapered configuration in order to prevent liquid flow there past when fluid flow guide 254 is not located opposite any of ports 104, 106 and 108.

[0045] It is a particular feature of an embodiment that fluid communication between opposite ends of bore 252 occurs in parallel to fluid communication along recess 253 at least in some of the mutual relative positions of the handle element 210 and housing element 100.

[0046] Fluid flow guide 254 directs the flow of liquid between ports 104 and 108 through recess 253 and into the internal volume 121 of port 106 for flushing thereof, when the handle element 210 is suitably positioned. Simultaneously, fluid flow is directed between ports 104 and 108 through bore 252, thereby increasing the fluid flow rate through the stopcock of Fig. 7.

[0047] It is specifically seen in Fig. 10A that in accordance with an embodiment IF not forming part of the present invention, the fluid flow guide 254 is formed as a fin having one generally straight inclined wall surface 258 and another generally concave wall surface 260, as specifically seen in Fig. 10A, both walls 258 and 260 are joined at the radially outward facing edge 256, which is adapted to extend to the vicinity of the inner surface of inner bore 119 of housing element 100. Both the inclined wall surface 258 and the concave wall surface 260 extend from the radially outward facing edge 256 to the vicinity of bore 252 and typically extend along a relatively minor longitudinal extent of bore 252.

[0048] Reference is now made to Fig. 11, which is a simplified exploded view illustration of a stopcock constructed and operative in accordance with still another

embodiment not forming part of the present invention.

[0049] As seen in Fig. 11, the stopcock comprises a housing element 100, which is preferably identical in all respects to housing element 100 which is illustrated and described with respect to Figs. 2A - 3B. The housing element 100 includes a main tubular portion 102 and three side ports, designated by reference numerals 104, 106 and 108 respectively. A handle element 310 in accordance with still another embodiment is arranged to be seated within main tubular portion 102 of housing element 100. It is also noted that a similar elastomeric element 114 and cap 116 are adapted to be seated within port 106 of the housing element 100, in a similar manner as described with respect to Figs. 1 - 3B.

[0050] Reference is now made to Figs. 12A - 13B, which are simplified pictorial illustrations of the handle element 310 forming part of the stopcock of Fig. 11 and to Figs. 14A - 14C, which are sectional illustrations thereof.

[0051] Shaft portion 330 is generally symmetrical about a shaft axis 342 and has a slightly conical outer surface 344, typically having an angle α (as seen particularly in Fig. 13A) of 3-4 degrees, which corresponds to the slightly conical configuration of central bore 119 for rotatable sealing engagement therewith. As seen particularly in Fig. 14C, shaft portion 330 is typically formed with mutually sealed top and bottom cylindrical recesses 346 and 348, which are sealingly separated by a divider 350.

[0052] At least one fluid flow passage is provided through handle element 310.

[0053] It is a particular feature of an embodiment that preferably two fluid flow passages are provided through handle element 310. This enables an increase of a fluid flow rate through the handle element 310. In accordance with an embodiment, the fluid flow rate is increased by at least 25%. In accordance with another embodiment the fluid flow rate is increased by at least 50%. For example, in a particular embodiment the fluid flow rate is increased from 300ml/min to 600ml/min.

[0054] It is a particular feature of an embodiment that the two fluid flow passages are interconnected in some of the mutual relative positions of the handle element 310 and the housing element 100 and that the two fluid flow passages are isolated in other of the mutual relative positions of the handle element 310 and the housing element 100 as described in detail hereinbelow.

[0055] Disposed generally between recesses 346 and 348 and sealed therefrom is a side-to-side extending bore 352, selectably defining a first fluid flow passageway between two of the selectable ones of side ports 104, 106 and 108 depending on the rotational orientation of the handle element 310 relative to the housing element 100. It is appreciated that in this particular embodiment, the side-to-side extending bore 352 has a semi-circular cross-section, however it is appreciated that bore 352 can alternatively have any other shape, such as circular, rectangular or other which provides the desired fluid flow rate.

[0056] Further disposed generally between recesses 346 and 348 and sealed therefrom is a partially peripherally-extending recess 353, selectably defining a second fluid flow passageway between selectable ones of side ports 104, 106 and 108 depending on the rotational orientation of the handle element 310 relative to the housing element 100. Preferably extending radially and partially bifurcating the recess 353 is a fluid flow guide 354, which is configured for directing the flow of liquid between any of ports 104 and 108 through the second fluid flow passageway defined by recess 353 into the internal volume 121 of port 106 for flushing thereof, when the handle element 310 is suitably positioned.

[0057] In an arrangement not forming part of the present invention, the radially outward facing edge 356 of fluid flow guide 354 extends preferably towards the inner surface of central bore 119 but is slightly spaced therefrom in order to provide minimal fluid flow passage there past when fluid flow guide 354 is not located opposite a port as shown and described in detail hereinbelow. In other arrangements, the fluid flow guide 354 may alternatively have many other shapes such that the radially outward facing edge 356 of fluid flow guide 354 is formed with a suitably tapered configuration in order to prevent liquid flow there past when fluid flow guide 354 is not located opposite any of ports 104, 106 and 108.

[0058] It is a particular feature of an embodiment that fluid communication between opposite ends of bore 352 occurs in parallel to fluid communication along recess 353 at least in part of the mutual relative positions of the handle element 310 and housing element 100.

[0059] Fluid flow guide 354 directs the flow of liquid between ports 104 and 108 through recess 353 and into the internal volume 121 of port 106 for flushing thereof, when the handle element 310 is suitably positioned. Simultaneously, fluid flow is directed between ports 104 and 108 through bore 352, thereby increasing the fluid flow rate through the stopcock of Fig. 11.

[0060] It is specifically seen in Fig. 14A that in accordance with an embodiment, the fluid flow guide 354 in accordance with an embodiment is formed as a fin having one generally concave wall surface 360 and another generally convex wall surface 362 connected with a generally straight wall surface 364. The straight wall surface 364 and the concave wall surface 360 are joined at the radially outward facing edge 356, which is adapted to extend to the vicinity of the inner surface of inner bore 119 of housing element 100. Both the convex wall surface 362 and the concave wall surface 360 extend from the radially outward facing edge 356 to the vicinity of bore 352 and typically extend along a relatively minor longitudinal extent of bore 352.

[0061] Reference is now made to Fig. 15, which is a simplified exploded view illustration of a stopcock constructed and operative in accordance with an embodiment of the present invention.

[0062] As seen in Fig. 15, the stopcock comprises a

housing element 100, which is preferably identical in all respects to housing element 100 which is illustrated and described with respect to Figs. 2A - 3B. The housing element 100 includes a main tubular portion 102 and three side ports, designated by reference numerals 104, 106 and 108 respectively. A handle element 410 in accordance with still another embodiment of the present invention is arranged to be seated within main tubular portion 102 of housing element 100. It is also noted that a similar elastomeric element 114 and cap 116 are adapted to be seated within port 106 of the housing element 100, in a similar manner as described with respect to Figs. 1 - 3B.

[0063] Reference is now made to Figs. 16A - 17B, which are simplified pictorial illustrations of the handle element 410 forming part of the stopcock of Fig. 15 and to Figs. 18A - 18C, which are sectional illustrations thereof.

[0064] Shaft portion 430 is generally symmetrical about a shaft axis 442 and has a slightly conical outer surface 444, typically having an angle α (as seen particularly in Fig. 17A) of 3-4 degrees, which corresponds to the slightly conical configuration of central bore 119 for rotatable sealing engagement therewith. As seen particularly in Fig. 18C, shaft portion 430 is typically formed with mutually sealed top and bottom cylindrical recesses 446 and 448, which are sealingly separated by a divider 450.

[0065] According to the present invention two fluid flow passages are provided through handle element 410. This enables an increase of a fluid flow rate through the handle element 410. In accordance with an embodiment of the present invention, the fluid flow rate is increased by at least 25%. In accordance with another embodiment of the present invention the fluid flow rate is increased by at least 50%. For example, in a particular embodiment of the present invention the fluid flow rate is increased from 300ml/min to 600ml/min.

[0066] It is a particular feature of an embodiment of the present invention that the two fluid flow passages are interconnected in some of the mutual relative positions of the handle element 410 and the housing element 100 and that the two fluid flow passages are isolated in other of the mutual relative positions of the handle element 410 and the housing element 100 as described in detail hereinbelow.

[0067] Disposed generally between recesses 446 and 448 and sealed therefrom is a side-to-side extending bore 452, selectably defining a first fluid flow passageway between two of the selectable ones of side ports 104, 106 and 108 depending on the rotational orientation of the handle element 410 relative to the housing element 100. It is appreciated that in this particular embodiment, the side-to-side extending bore 452 has an obround cross-section, however it is appreciated that bore 452 can alternatively have any other shape, such as circular, rectangular or other which provides the desired fluid flow rate.

[0068] Further disposed generally between recesses 446 and 448 and sealed therefrom is a partially peripherally-extending recess 453, selectably defining a second fluid flow passageway between selectable ones of side ports 104, 106 and 108 depending on the rotational orientation of the handle element 410 relative to the housing element 100. Preferably extending radially and partially bifurcating the recess 453 is a fluid flow guide 454, which is configured for directing the flow of liquid between any of ports 104 and 108 through the second fluid flow passageway defined by recess 453 into the internal volume 121 of port 106 for flushing thereof, when the handle element 410 is suitably positioned.

[0069] In an arrangement not forming part of the present invention, the radially outward facing edge 456 of fluid flow guide 454 extends preferably towards the inner surface of central bore 119 but is slightly spaced therefrom in order to provide minimal fluid flow passage there past when fluid flow guide 454 is not located opposite a port as shown and described in detail hereinbelow. In other arrangements forming part of the present invention, the fluid flow guide 454 may alternatively have many other shapes such that the radially outward facing edge 456 of fluid flow guide 454 is formed with a suitably tapered configuration in order to prevent liquid flow there past when fluid flow guide 454 is not located opposite any of ports 104, 106 and 108.

[0070] It is a particular feature of an embodiment of the present invention that fluid communication between opposite ends of bore 452 occurs in parallel to fluid communication along recess 453, at least in some operating positions of the stopcock of Fig. 15 at least in some of the mutual relative positions of the handle element 410 and housing element 100.

[0071] Fluid flow guide 454 directs the flow of liquid between ports 104 and 108 through recess 453 and into the internal volume 121 of port 106 for flushing thereof, when the handle element 410 is suitably positioned. Simultaneously, fluid flow is directed between ports 104 and 108 through bore 452, thereby increasing the fluid flow rate through the stopcock of Fig. 15.

[0072] It is specifically seen in Fig. 18A that in accordance with an embodiment of the present invention, the fluid flow guide 454 in accordance with an embodiment of the present invention is formed as a wedge having two symmetric generally concave wall surfaces 460. The concave wall surfaces 460 are joined at the radially outward facing edge 456, which is adapted to extend to the vicinity of the inner surface of inner bore 119 of housing element 100. The concave wall surfaces 460 extend from the radially outward facing edge 456 to the vicinity of bore 452 and typically extend along a relatively major longitudinal extent of bore 452, preferably along the entire longitudinal extent of bore 452.

[0073] It is noted that the concave wall surfaces 460 extend from the outward facing edge 456 towards the inner surface of the central bore 119 of main tubular portion 102 of the housing element 100, as seen and described in more detail hereinbelow.

[0074] It is a particular feature of an embodiment of the present invention bore 452 is generally spaced from recess 453 by fluid flow guide 454, therefore the first fluid flow passage is generally isolated from the second fluid flow passage at least in some of the mutual relative positions of the handle element 410 and housing element 100.

[0075] References is now made to Figs. 19A, 19B, 19C and 19D, which are simplified assembled pictorial illustrations of the stopcock of Fig. 1 in four operative orientations and to Figs. 20A, 20B, 20C and 20D, which are sectional illustrations of the stopcock having the handle shown in Figs. 4A - 6C, taken along section lines A - A, B - B, C - C and D - D in Figs. 19A, 19B, 19C and 19D respectively.

[0076] It is noted that port 104 is preferably connected to a patient, port 108 is preferably connected through an IV set to an infusion bag and port 106 is preferably adapted for insertion of a medical instrument, such as a syringe thereinto.

[0077] Figs. 19A and 20A illustrate a first operating position of the stopcock of Fig. 1, which is typically employed for blood pressure monitoring by means of a pressure transducer, where there should be no contact of fluid with the elastomeric element 114. In this first operating position, the handle element 110 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 134 is aligned with port 106 of the housing element 100 and extends along an axis, which is parallel to axis 118.

[0078] As seen in Fig. 20A, there is a fluid communication between ports 104 and 108 through first fluid flow passage defined by side-to-side extending bore 152, as indicated by an arrow 500. Liquid communication from port 108 to port 104 through second fluid flow passage, defined by recess 153, past fluid flow guide 154 is prevented, because it is blocked by fluid flow guide 154, whose edge 156 sealingly engages an inner facing wall of central bore 119 of housing element 100. This orientation may be utilized to provide fluid flow between ports 104 and 108 only.

[0079] It is appreciated that first fluid flow passage allows liquid communication between port 104 and 108 and liquid communication along the second fluid flow passage, particularly along recess 153, in this orientation is preferably blocked.

[0080] Alternatively, in accordance with another arrangement not forming part of the present invention, the fluid flow guide 154 can extend toward the inner facing wall of central bore 119 of housing element 100, whereas the edge 156 is slightly spaced therefrom in order to allow minimal fluid flow passage through the second fluid flow passage, along recess 153 and around fluid flow guide 154.

[0081] It is noted that liquid communication between port 104 and 108 through side-to-side bore 152 is sufficient for the purpose of pressure monitoring, while avoiding dampening of the signal, which could have occurred if the fluid would come in contact with elastomeric element 114.

[0082] Figs. 19B and 20B illustrate a second operating position of the stopcock of Fig. 1, where the handle element 110 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 134 is aligned with port 108 of the housing element 100 and extends along an axis, which is parallel to axis 117.

[0083] Figs. 19B and 20B illustrate a second operating position of the stopcock of Fig. 1, which is typically employed for drawing blood or other fluids from the patient. The user typically connects a syringe to port 106, such that the luer of the syringe penetrates elastomeric element 114, such that the luer of the syringe communicates with an internal volume 502 of the elastomeric element 114, and draws blood from the patient through port 104, via bore 152 as indicated by an arrow 504 and via recess 153 as indicated by an arrow 506, through port 106 to the syringe. It is appreciated that this operating position may also be used for supplying a medicament to the patient when port 108 is closed, in a flow direction opposite to that indicated by arrows 504 and 506.

[0084] It is particularly noted that in this operating position, a portion of fluid from port 104 enters the first fluid flow passage, defined by side-to-side bore 152. This portion of fluid flows along a portion of the second fluid flow passage, specifically along one side of the flat wall 160 and thereafter first concave portion 162 of the fluid flow guide 154, the fluid is then directed into side-to-side bore 152 and then in turn flows along side-to-side bore 152 into cylindrical bore 122 of port 106 and through the interior volume 502 of the elastomeric element 114 into the syringe, which is connected to port 106.

[0085] It is further particularly noted that the remaining portion of fluid from port 104 enters the second fluid flow passage, which is preferably defined by the circumferential recess 153, such that in this operating position, the fluid flows along another side of flat wall 160 and thereafter along the second concave portion 162 of the fluid flow guide 154, which effectively directs the flow into cylindrical bore 122 of port 106, and further into the internal volume 502 of the elastomeric element 114 and into the syringe, which is connected to port 106.

[0086] It is a particular feature of an embodiment invention that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 154. When the fluid flows along the flat wall 160 and the concave portions 162 of the fluid flow guide 154, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0087] It is appreciated that fluid flow rate increase is enabled by provision of the first fluid flow passage via bore 152 in addition to the second fluid flow passage defined by recess 153, while flushing characteristics of the stopcock due to the presence of fluid flow guides 154 and 128 are not compromised.

[0088] Figs. 19C and 20C illustrate a third operating position of the stopcock of Fig. 1, where the handle element 110 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 134 extends in a direction opposite to port 106 of the housing element 100 and extends along an axis, which is parallel to axis 118.

[0089] Figs. 19C and 20C illustrate a third operating position of the stopcock of Fig. 1, which is typically employed for supplying a liquid to the patient from port 108 to port 104. Liquid flows via the first fluid flow passage from port 108 via bore 152 and into port 104, as indicated by an arrow 508. Liquid also simultaneously flows via the second fluid flow passage from port 108 via recess 153, around fluid flow guide 154 into interior volume 121 of port 106 and thereafter around fluid flow guide 128 into internal volume 502 of the elastomeric element 114, thereby flushing residual liquid therefrom, and flowing further around fluid flow guides 128 and 154 into port 104 and to the patient, as indicated by an arrow 510.

[0090] It is particularly noted that in this operating position, a portion of fluid from port 108 enters the first fluid flow passage, defined by side-to-side bore 152. This portion of fluid flows entirely along side-to-side bore 152 and into port 104.

[0091] It is particularly noted that the remaining portion of the fluid from port 108 enters the second fluid flow passage, which is preferably defined by the circumferential recess 153, such that in this operating position, the fluid flows along the first concave portion 162 and thereafter along one side of flat wall 160 of the fluid flow guide 154, which effectively directs the entire fluid flow that enters the second fluid flow passage into cylindrical bore 122 of port 106. Further, due to the presence of fluid flow guide 128 within port 106, the fluid is directed along one side of the fluid flow guide 128 into the internal volume 502 of the elastomeric element 114 and while flushing this internal volume, the fluid is directed along the other side of fluid flow guide 128, thereafter along the other side of flat wall 160 and the second concave portion 162 of the fluid flow guide 154 and eventually into port 104, as indicated by arrow 510.

[0092] It is a particular feature of an embodiment of the present invention that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 154. When the fluid flows along the flat wall 160 and the concave portions 162 of the fluid flow guide 154, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0093] The provision of fluid flow guides 154 and 128 generally overcomes problems of the presence of residual liquids remaining in the internal volume 121 of port 106 as well as in internal volume 502 of the elastomeric element 114. This is important in various therapeutic situations. For example when blood is drawn from the patient through port 106, there remains residual blood in the internal volume 121 of port 106 and the internal volume 502 of the elastomeric element 114. This blood, if left in internal volumes 121 and 502 for a period of time, can clot and thus become dangerous if delivered to the patient. In addition, the coagulated blood could occlude the liquid passageway extending through port 106. Various infections could possibly arise as a result of the retained blood.

[0094] This feature is also useful when a medicament is supplied to a patient through port 106. If a portion of the medicament remains in the internal volumes 121 of port 106 and 502 of the elastomeric element 114, the dosage of the medicament that the patient receives is less than the intended dosage by an amount which cannot be readily ascertained. In addition, this residual medicament might be inadvertently supplied to the patient during a subsequent use of the stopcock, which could cause harm to the patient.

[0095] The present disclosure invention provides for automatic flushing of the liquid, such as blood or medicament from the internal volumes 121 and 502 and typically returning it to the patient without requiring the use of extra syringes and the opening of the medical set to the atmosphere, thereby increasing the chance of contamination.

[0096] It is an additional particular feature of an embodiment that first fluid flow passage through side-to-side bore 152 is provided for increasing the flow rate through the stopcock of Fig. 1 while maintaining the flushing feature of volumes 121 and 502 via the second fluid flow passage.

[0097] Figs. 19D and 20D illustrate a fourth operating position of the stopcock of Fig. 1, where the handle element 110 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 134 is aligned with port 104 of the housing element 100 and extends along an axis, which is parallel to axis 117.

[0098] Figs. 19D and 20D illustrate a fourth operating position of the stopcock of Fig. 1, which may be used for flushing the IV set upstream of the stopcock, when port 106 is open to the atmosphere as by insertion of a male luer connector, such as a syringe tip (not shown), into the elastomeric element 114 of the valve thereof. The insertion of the male luer connector activates the flow of liquid from port 108 via the first fluid flow through bore 152 and into port 106, as indicated by an arrow 512. Liquid also simultaneously flows via the second fluid flow passage from port 108 via recess 153, around fluid flow guide 154 into interior volume 121 of port 106 and thereafter around fluid flow guide 128 into internal volume 502 of the elastomeric element 114, flushing residual liquid therefrom, via port 106 to the IV line, as indicated by an arrow 514.

[0099] It is particularly noted that in this operating position, a portion of fluid from port 108 enters the first fluid flow passage, defined by side-to-side bore 152. This portion of fluid flows along a portion of the second fluid flow passage, specifically along one side of the flat wall 160

and thereafter first concave portion 162 of the fluid flow guide 154, the fluid is then directed into side-to-side bore 152 and then in turn flows along side-to-side bore 152 into cylindrical bore 122 of port 106 and through the interior volume 502 of the elastomeric element 114 into the syringe, which is connected to port 106.

[0100] It is particularly noted that the remaining portion of fluid from port 108 enters the second fluid flow passage, which is preferably defined by the circumferential recess 153, such that in this operating position, the fluid flows along another side of flat wall 160 and thereafter the second concave portion 162 of the fluid flow guide 154, which effectively directs the flow into cylindrical bore 122 of port 106, and further into the internal volume 502 of the elastomeric element 114 and into the syringe, which is connected to port 106.

[0101] It is a particular feature of an embodiment that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 154. When the fluid flows along the flat wall 160 and the concave portions 162 of the fluid flow guide 154, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0102] Alternatively, this operating position may be employed for pushing liquid via the side port 106, through port 108, in a direction opposite arrows 512 and 514, for uses such as mixing liquid in the pressure bag.

[0103] It is appreciated that fluid flow rate increase is enabled by provision of the first fluid flow passage via bore 152 in addition to the second fluid flow passage defined by recess 153, while flushing characteristics of the stopcock due to the presence of fluid flow guides 154 and 128 are not compromised.

[0104] References is now made to Figs. 19A, 19B, 19C and 19D, which are simplified assembled pictorial illustrations of the stopcock of Fig. 7 in four operative orientations and to Figs. 21A, 21B, 21C and 21D, which are sectional illustrations of the stopcock having the handle shown in Figs. 8A - 10C, taken along section lines A - A, B - B, C - C and D - D in Figs. 19A, 19B, 19C and 19D respectively.

[0105] Figs. 19A and 21A illustrate a first operating position of the stopcock of Fig. 7, which is typically employed for blood pressure monitoring by means of a pressure transducer, where there should be no contact of fluid with the elastomeric element 114. In this first operating position, the handle element 210 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 234 is aligned with port 106 of the housing element 100 and extends along an axis, which is parallel to axis 118.

[0106] As seen in Fig. 21A, there is a fluid communication between ports 104 and 108 through first fluid flow passage defined by side-to-side extending bore 252, as indicated by an arrow 600. Liquid communication from port 108 to port 104 through second fluid flow passage, defined by recess 253, past fluid flow guide 254 is prevented, because it is blocked by fluid flow guide 254, whose edge 256 sealingly engages an inner facing wall of central bore 119 of housing element 100. This orientation may be utilized to provide fluid flow between ports 104 and 108 only.

[0107] It is appreciated that first fluid flow passage allows liquid communication between port 104 and 108 and liquid communication along the second fluid flow passage, particularly along recess 253, in this orientation is preferably blocked.

[0108] Alternatively, in accordance with another arrangement not forming part of the present invention, the fluid flow guide 254 can extend toward the inner facing wall of central bore 119 of housing element 100, whereas the edge 256 is slightly spaced therefrom in order to allow minimal fluid flow passage through the second fluid flow passage, along recess 253 and around fluid flow guide 254.

[0109] It is noted that liquid communication between port 104 and 108 through side-to-side bore 252 is sufficient for the purpose of pressure monitoring, while avoiding dampening of the signal, which could have occurred if the fluid would come in contact with elastomeric element 114.

[0110] Figs. 19B and 20B illustrate a second operating position of the stopcock of Fig. 7, where the handle element 210 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 234 is aligned with port 108 of the housing element 100 and extends along an axis, which is parallel to axis 117.

[0111] Figs. 19B and 21B illustrate a second operating position of the stopcock of Fig. 7, which is typically employed for drawing blood or other fluids from the patient. The user typically connects a syringe to port 106, such that the luer of the syringe penetrates elastomeric element 114, such that the luer of the syringe communicates with an internal volume 502 of the elastomeric element 114, and draws blood from the patient through port 104, via bore 252 as indicated by an arrow 604 and via recess 253 as indicated by an arrow 606, through port 106 to the syringe. It is appreciated that this operating position may also be used for supplying a medicament to the patient when port 108 is closed, in a flow direction opposite to that indicated by arrows 604 and 606.

[0112] It is particularly noted that in this operating position, a portion of fluid from port 104 enters the first fluid flow passage, defined by side-to-side bore 252. This portion of fluid flows along a portion of the second fluid flow passage, specifically along inclined wall surface 258 of the fluid flow guide 254, the fluid is then directed into side-to-side bore 252 and then in turn flows along side-to-side bore 252 into cylindrical bore 122 of port 106 and through the interior volume 502 of the elastomeric element 114 into the syringe, which is connected to port 106.

[0113] It is further particularly noted that the remaining portion of fluid from port 104 enters the second fluid flow passage, which is preferably defined by the circumferential recess 253, such that in this operating position, the

fluid flows along concave wall surface 260 of the fluid flow guide 254, which effectively directs the flow into cylindrical bore 122 of port 106, and further into the internal volume 502 of the elastomeric element 114 and into the syringe, which is connected to port 106.

[0114] It is a particular feature of an embodiment that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 254. When the fluid flows along inclined wall surface 258 of the fluid flow guide 254, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0115] It is appreciated that fluid flow rate increase is enabled by provision of the first fluid flow passage via bore 252 in addition to the second fluid flow passage defined by recess 253, while flushing characteristics of the stopcock due to the presence of fluid flow guides 254 and 128 are not compromised.

[0116] Figs. 19C and 21C illustrate a third operating position of the stopcock of Fig. 7, where the handle element 210 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 234 extends in a direction opposite to port 106 of the housing element 100 and extends along an axis, which is parallel to axis 118.

[0117] Figs. 19C and 21C illustrate a third operating position of the stopcock of Fig. 7, which is typically employed for supplying a liquid to the patient from port 108 to port 104. Liquid flows via the first fluid flow passage from port 108 via bore 252 and into port 104, as indicated by an arrow 608. Liquid also simultaneously flows via the second fluid flow passage from port 108 via recess 253, around fluid flow guide 254 into interior volume 121 of port 106 and thereafter around fluid flow guide 128 into internal volume 502 of the elastomeric element 114, thereby flushing residual liquid therefrom, and flowing further around fluid flow guides 128 and 254 into port 104 and to the patient, as indicated by an arrow 610.

[0118] It is particularly noted that in this operating position, a portion of fluid from port 108 enters the first fluid flow passage, defined by side-to-side bore 252. This portion of fluid flows entirely along side-to-side bore 252 and into port 104.

[0119] It is particularly noted that the remaining portion of the fluid from port 108 enters the second fluid flow passage, which is preferably defined by the circumferential recess 253, such that in this operating position, the fluid flows along concave wall surface 260 of the fluid flow guide 254, which effectively directs the entire fluid flow that enters the second fluid flow passage into cylindrical bore 122 of port 106. Further, due to the presence of fluid flow guide 128 within port 106, the fluid is directed along one side of the fluid flow guide 128 into the internal volume 502 of the elastomeric element 114 and while flushing this internal volume, the fluid is directed along the other side of fluid flow guide 128, thereafter along inclined wall surface 258 of the fluid flow guide 254 and eventually into port 104, as indicated by arrow 610.

[0120] It is a particular feature of an embodiment that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 254. When the fluid flows along the concave wall surface 260 and along inclined wall surface 158 of the fluid flow guide 254, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0121] It is a particular feature of the present disclosure that the provision of fluid flow guides 254 and 128 generally overcomes problems of the presence of residual liquids remaining in the internal volume 121 of port 106 as well as in internal volume 502 of the elastomeric element 114. This is important in various therapeutic situations. For example, when blood is drawn from the patient through port 106, there remains residual blood in the internal volume 121 of port 106 and the internal volume 502 of the elastomeric element 114. This blood, if left in internal volumes 121 and 502 for a period of time, can clot and thus become dangerous if delivered to the patient. In addition, the coagulated blood could occlude the liquid passageway extending through port 106. Various infections could possibly arise as a result of the retained blood.

[0122] This feature is also useful when a medicament is supplied to a patient through port 106. If a portion of the medicament remains in the internal volumes 121 of port 106 and 502 of the elastomeric element 114, the dosage of the medicament that the patient receives is less than the intended dosage by an amount which cannot be readily ascertained. In addition, this residual medicament might be inadvertently supplied to the patient during a subsequent use of the stopcock, which could cause harm to the patient.

[0123] The present invention provides for automatic flushing of the liquid, such as blood or medicament from the internal volumes 121 and 502 and typically returning it to the patient without requiring the use of extra syringes and the opening of the medical set to the atmosphere, thereby increasing the chance of contamination.

[0124] It is an additional particular feature of an embodiment that first fluid flow passage through side-to-side bore 252 is provided for increasing the flow rate through the stopcock of Fig. 7 while maintaining the flushing feature of volumes 121 and 502 via the second fluid flow passage.

[0125] Figs. 19D and 21D illustrate a fourth operating position of the stopcock of Fig. 7, where the handle element 210 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 234 is aligned with port 104 of the housing element 100 and extends along an axis, which is parallel to axis 117.

[0126] Figs. 19D and 21D illustrate a fourth operating position of the stopcock of Fig. 7, which may be used for flushing the IV set upstream of the stopcock, when port 106 is open to the atmosphere as by insertion of a male luer connector, such as a syringe tip (not shown), into

the elastomeric element 114 of the valve thereof. The insertion of the male luer connector activates the flow of liquid from port 108 via the first fluid flow through bore 252 and into port 106, as indicated by an arrow 612. Liquid also simultaneously flows via the second fluid flow passage from port 108 via recess 253, around fluid flow guide 254 into interior volume 121 of port 106 and thereafter around fluid flow guide 128 into internal volume 502 of the elastomeric element 114, flushing residual liquid therefrom, via port 106 to the IV line, as indicated by an arrow 614.

[0127] It is particularly noted that in this operating position, a portion of fluid from port 108 enters the first fluid flow passage, defined by side-to-side bore 252. This portion of fluid flows along a portion of the second fluid flow passage, specifically along concave wall surface 260 of the fluid flow guide 254, the fluid is then directed into side-to-side bore 252 and then in turn flows along side-to-side bore 252 into cylindrical bore 122 of port 106 and through the interior volume 502 of the elastomeric element 114 into the syringe, which is connected to port 106.

[0128] It is particularly noted that the remaining portion of fluid from port 108 enters the second fluid flow passage, which is preferably defined by the circumferential recess 253, such that in this operating position, the fluid flows along inclined wall surface 258 of the fluid flow guide 254, which effectively directs the flow into cylindrical bore 122 of port 106, and further into the internal volume 502 of the elastomeric element 114 and into the syringe, which is connected to port 106.

[0129] It is a particular feature of an embodiment that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 254. When the fluid flows along the concave wall surface 260 of the fluid flow guide 254, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0130] Alternatively, this operating position may be employed for pushing liquid via the side port 106, through port 108, in a direction opposite arrows 612 and 614, for uses such as mixing liquid in the pressure bag.

[0131] It is appreciated that fluid flow rate increase is enabled by provision of the first fluid flow passage via bore 252 in addition to the second fluid flow passage defined by recess 253, while flushing characteristics of the stopcock due to the presence of fluid flow guides 254 and 128 are not compromised.

[0132] References is now made to Figs. 19A, 19B, 19C and 19D, which are simplified assembled pictorial illustrations of the stopcock of Fig. 11 in four operative orientations and to Figs. 22A, 22B, 22C and 22D, which are sectional illustrations of the stopcock having the handle shown in Figs. 12A - 14C, taken along section lines A - A, B - B, C - C and D - D in Figs. 19A, 19B, 19C and 19D respectively.

[0133] Figs. 19A and 22A illustrate a first operating position of the stopcock of Fig. 11, which is typically employed for blood pressure monitoring by means of a pressure transducer, where there should be no contact of fluid with the elastomeric element 114. In this first operating position, the handle element 310 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 334 is aligned with port 106 of the housing element 100 and extends along an axis, which is parallel to axis 118.

[0134] As seen in Fig. 22A, there is a fluid communication between ports 104 and 108 through first fluid flow passage defined by side-to-side extending bore 352, as indicated by an arrow 700. Liquid communication from port 108 to port 104 through second fluid flow passage, defined by recess 353, past fluid flow guide 354 is prevented, because it is blocked by fluid flow guide 354, whose edge 356 sealingly engages an inner facing wall of central bore 119 of housing element 100. This orientation may be utilized to provide fluid flow between ports 104 and 108 only.

[0135] It is appreciated that first fluid flow passage allows liquid communication between port 104 and 108 and liquid communication along the second fluid flow passage, particularly along recess 353, in this orientation is preferably blocked.

[0136] Alternatively, in accordance with another arrangement not forming part of the present invention, the fluid flow guide 354 can extend toward the inner facing wall of central bore 119 of housing element 100, whereas the edge 356 is slightly spaced therefrom in order to allow minimal fluid flow passage through the second fluid flow passage, along recess 353 and around fluid flow guide 354.

[0137] It is noted that liquid communication between port 104 and 108 through side-to-side bore 352 is sufficient for the purpose of pressure monitoring, while avoiding dampening of the signal, which could have occurred if the fluid would come in contact with elastomeric element 114.

[0138] Figs. 19B and 22B illustrate a second operating position of the stopcock of Fig. 11, where the handle element 310 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 334 is aligned with port 108 of the housing element 100 and extends along an axis, which is parallel to axis 117.

[0139] Figs. 19B and 22B illustrate a second operating position of the stopcock of Fig. 11, which is typically employed for drawing blood or other fluids from the patient. The user typically connects a syringe to port 106, such that the luer of the syringe penetrates elastomeric element 114, such that the luer of the syringe communicates with an internal volume 502 of the elastomeric element 114, and draws blood from the patient through port 104, via bore 352 as indicated by an arrow 704 and via recess 353 as indicated by an arrow 706, through port 106 to the syringe. It is appreciated that this operating position may also be used for supplying a medicament to the patient when port 108 is closed, in a flow direction opposite to that indicated by arrows 704 and 706.

[0140] It is particularly noted that in this operating position, a portion of fluid from port 104 enters the first fluid flow passage, defined by side-to-side bore 352. This portion of fluid flows along a portion of the second fluid flow passage, specifically along straight wall surface 364 and thereafter convex wall surface 362 of the fluid flow guide 354, the fluid is then directed into side-to-side bore 352 and then in turn flows along side-to-side bore 352 into cylindrical bore 122 of port 106 and through the interior volume 502 of the elastomeric element 114 into the syringe, which is connected to port 106.

[0141] It is further particularly noted that the remaining portion of fluid from port 104 enters the second fluid flow passage, which is preferably defined by the circumferential recess 353, such that in this operating position, the fluid flows along concave wall surface 360 of the fluid flow guide 354, which effectively directs the flow into cylindrical bore 122 of port 106, and further into the internal volume 502 of the elastomeric element 114 and into the syringe, which is connected to port 106.

[0142] It is a particular feature of an embodiment that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 354. When the fluid flows along straight wall surface 364 and thereafter convex wall surface 362 of the fluid flow guide 354, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0143] It is appreciated that fluid flow rate increase is enabled by provision of the first fluid flow passage via bore 352 in addition to the second fluid flow passage defined by recess 353, while flushing characteristics of the stopcock due to the presence of fluid flow guides 354 and 128 are not compromised.

[0144] Figs. 19C and 22C illustrate a third operating position of the stopcock of Fig. 11, where the handle element 310 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 334 extends in a direction opposite to port 106 of the housing element 100 and extends along an axis, which is parallel to axis 118.

[0145] Figs. 19C and 22C illustrate a third operating position of the stopcock of Fig. 11, which is typically employed for supplying a liquid to the patient from port 108 to port 104. Liquid flows via the first fluid flow passage from port 108 via bore 352 and into port 104, as indicated by an arrow 708. Liquid also simultaneously flows via the second fluid flow passage from port 108 via recess 353, around fluid flow guide 354 into interior volume 121 of port 106 and thereafter around fluid flow guide 128 into internal volume 502 of the elastomeric element 114, thereby flushing residual liquid therefrom, and flowing further around fluid flow guides 128 and 354 into port 104 and to the patient, as indicated by an arrow 710.

[0146] It is particularly noted that in this operating position, a portion of fluid from port 108 enters the first fluid flow passage, defined by side-to-side bore 352. This portion of fluid flows entirely along side-to-side bore 352 and into port 104.

[0147] It is particularly noted that the remaining portion of the fluid from port 108 enters the second fluid flow passage, which is preferably defined by the circumferential recess 353, such that in this operating position, the fluid flows along concave wall surface 360 of the fluid flow guide 354, which effectively directs the entire fluid flow that enters the second fluid flow passage into cylindrical bore 122 of port 106. Further, due to the presence of fluid flow guide 128 within port 106, the fluid is directed along one side of the fluid flow guide 128 into the internal volume 502 of the elastomeric element 114 and while flushing this internal volume, the fluid is directed along the other side of fluid flow guide 128, thereafter along straight wall surface 364 and convex wall surface 362 of the fluid flow guide 354 and eventually into port 104, as indicated by arrow 710.

[0148] It is a particular feature of an embodiment that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 354. When the fluid flows along concave wall surface 360 and then straight wall surface 364 and thereafter convex wall surface 362 of the fluid flow guide 354, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0149] It is a particular feature of the present disclosure that the provision of fluid flow guides 354 and 128 generally overcomes problems of the presence of residual liquids remaining in the internal volume 121 of port 106 as well as in internal volume 502 of the elastomeric element 114. This is important in various therapeutic situations. For example, when blood is drawn from the patient through port 106, there remains residual blood in the internal volume 121 of port 106 and the internal volume 502 of the elastomeric element 114. This blood, if left in internal volumes 121 and 502 for a period of time, can clot and thus become dangerous if delivered to the patient. In addition, the coagulated blood could occlude the liquid passageway extending through port 106. Various infections could possibly arise as a result of the retained blood.

[0150] This feature is also useful when a medicament is supplied to a patient through port 106. If a portion of the medicament remains in the internal volumes 121 of port 106 and 502 of the elastomeric element 114, the dosage of the medicament that the patient receives is less than the intended dosage by an amount which cannot be readily ascertained. In addition, this residual medicament might be inadvertently supplied to the patient during a subsequent use of the stopcock, which could cause harm to the patient.

[0151] The present invention provides for automatic flushing of the liquid, such as blood or medicament from the internal volumes 121 and 502 and typically returning it to the patient without requiring the use of extra syringes and the opening of the medical set to the atmosphere, thereby increasing the chance of contamination.

[0152] It is an additional particular feature of an em-

bodiment that first fluid flow passage through side-to-side bore 352 is provided for increasing the flow rate through the stopcock of Fig. 11 while maintaining the flushing feature of volumes 121 and 502 via the second fluid flow passage.

[0153] Figs. 19D and 22D illustrate a fourth operating position of the stopcock of Fig. 11, where the handle element 310 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 334 is aligned with port 104 of the housing element 100 and extends along an axis, which is parallel to axis 117.

[0154] Figs. 19D and 22D illustrate a fourth operating position of the stopcock of Fig. 11, which may be used for flushing the IV set upstream of the stopcock, when port 106 is open to the atmosphere as by insertion of a male luer connector, such as a syringe tip (not shown), into the elastomeric element 114 of the valve thereof. The insertion of the male luer connector activates the flow of liquid from port 108 via the first fluid flow through bore 352 and into port 106, as indicated by an arrow 712. Liquid also simultaneously flows via the second fluid flow passage from port 108 via recess 353, around fluid flow guide 354 into interior volume 121 of port 106 and thereafter around fluid flow guide 128 into internal volume 502 of the elastomeric element 114, flushing residual liquid therefrom, via port 106 to the IV line, as indicated by an arrow 714.

[0155] It is particularly noted that in this operating position, a portion of fluid from port 108 enters the first fluid flow passage, defined by side-to-side bore 352. This portion of fluid flows along a portion of the second fluid flow passage, specifically along concave wall surface 360 of the fluid flow guide 354, the fluid is then directed into side-to-side bore 352 and then in turn flows along side-to-side bore 352 into cylindrical bore 122 of port 106 and through the interior volume 502 of the elastomeric element 114 into the syringe, which is connected to port 106.

[0156] It is particularly noted that the remaining portion of fluid from port 108 enters the second fluid flow passage, which is preferably defined by the circumferential recess 353, such that in this operating position, the fluid flows along straight wall surface 364 and convex wall surface 362 of the fluid flow guide 354, which effectively directs the flow into cylindrical bore 122 of port 106, and further into the internal volume 502 of the elastomeric element 114 and into the syringe, which is connected to port 106.

[0157] It is a particular feature of an embodiment that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 354. When the fluid flows along concave wall surface 360 of the fluid flow guide 354, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0158] Alternatively, this operating position may be employed for pushing liquid via the side port 106, through port 108, in a direction opposite arrows 712 and 714, for uses such as mixing liquid in the pressure bag.

[0159] It is appreciated that fluid flow rate increase is enabled by provision of the first fluid flow passage via bore 352 in addition to the second fluid flow passage defined by recess 353, while flushing characteristics of the stopcock due to the presence of fluid flow guides 354 and 128 are not compromised.

[0160] References is now made to Figs. 19A, 19B, 19C and 19D, which are simplified assembled pictorial illustrations of the stopcock of Fig. 15 in four operative orientations and to Figs. 23A, 23B, 23C and 23D, which are sectional illustrations of the stopcock having the handle shown in Figs. 16A - 18C, taken along section lines A - A, B - B, C - C and D - D in Figs. 19A, 19B, 19C and 19D respectively.

[0161] Figs. 19A and 23A illustrate a first operating position of the stopcock of Fig. 15, which is typically employed for blood pressure monitoring by means of a pressure transducer, where there should be no contact of fluid with the elastomeric element 114. In this first operating position, the handle element 410 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 434 is aligned with port 106 of the housing element 100 and extends along an axis, which is parallel to axis 118.

[0162] As seen in Fig. 23A, there is a fluid communication between ports 104 and 108 through first fluid flow passage defined by side-to-side extending bore 452, as indicated by an arrow 800. Liquid communication from port 108 to port 104 through second fluid flow passage, defined by recess 453, past fluid flow guide 454 is prevented, because it is blocked by fluid flow guide 454, whose edge 456 sealingly engages an inner facing wall of central bore 119 of housing element 100. This orientation may be utilized to provide fluid flow between ports 104 and 108 only.

[0163] It is appreciated that first fluid flow passage allows liquid communication between port 104 and 108 and liquid communication along the second fluid flow passage, particularly along recess 453, in this orientation is preferably blocked.

[0164] Alternatively, in accordance with another arrangement not forming part of the present invention, the fluid flow guide 454 can extend toward the inner facing wall of central bore 119 of housing element 100, whereas the edge 456 is slightly spaced therefrom in order to allow minimal fluid flow passage through the second fluid flow passage, along recess 453 and around fluid flow guide 454.

[0165] It is noted that liquid communication between port 104 and 108 through side-to-side bore 452 is sufficient for the purpose of pressure monitoring, while avoiding dampening of the signal, which could have occurred if the fluid would come in contact with elastomeric element 114.

[0166] Figs. 19B and 23B illustrate a second operating position of the stopcock of Fig. 15, where the handle element 410 is rotatably disposed within the main tubular

portion 102 of the housing element 100, such that finger engageable protrusion 534 is aligned with port 108 of the housing element 100 and extends along an axis, which is parallel to axis 117.

[0167] Figs. 19B and 23B illustrate a second operating position of the stopcock of Fig. 15, which is typically employed for drawing blood or other fluids from the patient. The user typically connects a syringe to port 106, such that the luer of the syringe penetrates elastomeric element 114, such that the luer of the syringe communicates with an internal volume 502 of the elastomeric element 114, and draws blood from the patient through port 104, via recess 453 as indicated by an arrow 806, through port 106 to the syringe. It is appreciated that this operating position may also be used for supplying a medicament to the patient when port 108 is closed, in a flow direction opposite to that indicated by arrow 806.

[0168] It is particularly noted that in this operating position, due to the fact that the side-to-side bore 452 is isolated from the recess 453, the entire fluid flow from port 104 enters the second fluid flow passage, which is preferably defined by the circumferential recess 453, such that in this operating position, the fluid flows along concave wall surface 460 of the fluid flow guide 454, which effectively directs the flow into cylindrical bore 122 of port 106, and further into the internal volume 502 of the elastomeric element 114 and into the syringe, which is connected to port 106. There is no fluid flow through the side-to-side bore 452 in this second operating orientation of the stopcock.

[0169] Figs. 19C and 23C illustrate a third operating position of the stopcock of Fig. 15, where the handle element 410 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 434 extends in a direction opposite to port 106 of the housing element 100 and extends along an axis, which is parallel to axis 118.

[0170] Figs. 19C and 23C illustrate a third operating position of the stopcock of Fig. 15, which is typically employed for supplying a liquid to the patient from port 108 to port 104. Liquid flows via the first fluid flow passage from port 108 via bore 452 and into port 104, as indicated by an arrow 808. Liquid also simultaneously flows via the second fluid flow passage from port 108 via recess 453, around fluid flow guide 454 into interior volume 121 of port 106 and thereafter around fluid flow guide 128 into internal volume 502 of the elastomeric element 114, thereby flushing residual liquid therefrom, and flowing further around fluid flow guides 128 and 454 into port 104 and to the patient, as indicated by an arrow 810.

[0171] It is particularly noted that in this operating position, a portion of fluid from port 108 enters the first fluid flow passage, defined by side-to-side bore 452. This portion of fluid flows entirely along side-to-side bore 452 and into port 104.

[0172] It is particularly noted that the remaining portion of the fluid from port 108 enters the second fluid flow passage, which is preferably defined by the circumferential recess 453, such that in this operating position, the fluid flows along the first concave wall surface 460 of the fluid flow guide 454, which effectively directs the entire fluid flow that enters the second fluid flow passage into cylindrical bore 122 of port 106. Further, due to the presence of fluid flow guide 128 within port 106, the fluid is directed along one side of the fluid flow guide 128 into the internal volume 502 of the elastomeric element 114 and while flushing this internal volume, the fluid is directed along the other side of fluid flow guide 128, thereafter along the second concave wall surface 460 of the fluid flow guide 454 and eventually into port 104, as indicated by arrow 810.

[0173] It is a particular feature of an embodiment of the present invention that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 454. When the fluid flows along concave wall surfaces 460 of the fluid flow guide 454, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0174] It is a particular feature of an embodiment of the present invention that the flow of liquid from port 108 is bifurcated right upon reaching the main tubular portion 102 of housing element 100, due to the fact that concave wall surface 460 extends along a majority of the longitudinal extent of side-to-side extending bore 452. Specifically, the fact that the concave wall surface 460 extends to the vicinity of the inner facing wall of the central bore 119, causes liquid flowing from port 108 to be bifurcated right upon reaching main tubular element 102 of the housing element 100, thus assuring that a significant portion of liquid from port 108 flows into peripherally-extending recess 453, as indicated by arrow 810, and further into interior volume 121 of port 106 and into internal volume 502 of the elastomeric element 114 in order to provide proper flushing of both the internal volume 502 and of the interior volume 121. It is noted that the remaining portion of liquid from port 108 simultaneously flows through side-to-side extending bore 452, as indicated by arrow 808, in this third operating position of the stopcock in order to increase the flow rate of liquid flowing from port 108 to port 104.

[0175] It is a particular feature of the present invention that the provision of fluid flow guides 454 and 128 generally overcomes problems of the presence of residual liquids remaining in the internal volume 121 of port 106 as well as in internal volume 502 of the elastomeric element 114. This is important in various therapeutic situations. For example, when blood is drawn from the patient through port 106, there remains residual blood in the internal volume 121 of port 106 and the internal volume 502 of the elastomeric element 114. This blood, if left in internal volumes 121 and 502 for a period of time, can clot and thus become dangerous if delivered to the patient. In addition, the coagulated blood could occlude the liquid passageway extending through port 106. Various infections could possibly arise as a result of the retained blood.

[0176] This feature is also useful when a medicament is supplied to a patient through port 106. If a portion of the medicament remains in the internal volumes 121 of port 106 and 502 of the elastomeric element 114, the dosage of the medicament that the patient receives is less than the intended dosage by an amount which cannot be readily ascertained. In addition, this residual medicament might be inadvertently supplied to the patient during a subsequent use of the stopcock, which could cause harm to the patient.

[0177] The present invention provides for automatic flushing of the liquid, such as blood or medicament from the internal volumes 121 and 502 and typically returning it to the patient without requiring the use of extra syringes and the opening of the medical set to the atmosphere, thereby increasing the chance of contamination.

[0178] It is an additional particular feature of an embodiment of the present invention that first fluid flow passage through side-to-side bore 452 is provided for increasing the flow rate through the stopcock of Fig. 15 while maintaining the flushing feature of volumes 121 and 502 via the second fluid flow passage.

[0179] Figs. 19D and 23D illustrate a fourth operating position of the stopcock of Fig. 15, where the handle element 410 is rotatably disposed within the main tubular portion 102 of the housing element 100, such that finger engageable protrusion 434 is aligned with port 104 of the housing element 100 and extends along an axis, which is parallel to axis 117.

[0180] Figs. 19D and 23D illustrate a fourth operating position of the stopcock of Fig. 15, which may be used for flushing the IV set upstream of the stopcock, when port 106 is open to the atmosphere as by insertion of a male luer connector, such as a syringe tip (not shown), into the elastomeric element 114 of the valve thereof. The insertion of the male luer connector activates the flow of liquid from port 108 via the the second fluid flow passage through recess 453, around fluid flow guide 354 into interior volume 121 of port 106 and thereafter around fluid flow guide 128 into internal volume 502 of the elastomeric element 114, flushing residual liquid therefrom, via port 106 to the IV line, as indicated by an arrow 814.

[0181] It is particularly noted that in this operating position, due to the fact that the side-to-side bore 452 is isolated from the recess 453, the entire amount of fluid from port 108 enters the second fluid flow passage, which is preferably defined by the circumferential recess 453, such that in this operating position, the fluid flows along concave wall surface 460 of the fluid flow guide 454, which effectively directs the flow into cylindrical bore 122 of port 106, and further into the internal volume 502 of the elastomeric element 114 and into the syringe, which is connected to port 106.

[0182] It is a particular feature of an embodiment of the present invention that the second fluid flow passage has various configurations in accordance with the configuration of the fluid flow guide 454. When the fluid flows along concave wall surface 460 of the fluid flow guide 454, a smooth laminar flow of liquid is provided and singularity points along the fluid flow passage are prevented.

[0183] Alternatively, this operating position may be employed for pushing liquid via the side port 106, through port 108, in a direction opposite arrow 814, for uses such as mixing liquid in the pressure bag.

[0184] It is appreciated that the stopcock in accordance with embodiments illustrated in Figs. 1 - 23D is operable is an arterial monitoring set. The arterial monitoring set generally includes a fluid-filled bag and a tube portion leading to a patient's artery. An arterial pressure sensor is coupled in a series along the tube portion and provides a visible output on a conventional monitor. Downstream of arterial pressure sensor there is provided the stopcock of the type described hereinabove with reference to any of Figs. 1 - 23D, including a swabbable valve having an elastomeric element 114.

[0185] Stopcock such as shown and illustrated in Figs. 19A, 20A, 21A, 22A and 23A is preferably used for transferring liquid through an arterial set, including the stopcock, from the bag to the artery of the patient.

[0186] Stopcock such as shown and illustrated in Figs. 19B, 20B, 21B, 22B and 23B, is typically employed for drawing blood or other fluids from the patient, by employing a syringe coupled to the swabbable valve. It is appreciated that this operating position may also be used for supplying medicament to the patient via syringe.

[0187] Stopcock such as shown and illustrated in Figs. 19C, 20C, 21C, 22C and 23C, is typically employed for supplying a liquid to the patient from the arterial set. Liquid flows through the stopcock and flushes the internal volume of the swabbable valve and of the port in which it is located, flushing residual liquid therefrom to the patient.

[0188] Stopcock such as shown and illustrated in Figs. 19D, 20D, 21D, 22D and 23D, is typically employed for flushing the IV set upstream of the stopcock, when port 106 is open to the atmosphere as by insertion of a male luer connector, such as a syringe tip (not shown), into the elastomeric element 114 of the valve thereof.

[0189] Because it enables an operator to easily draw blood without exposing the arterial line to the atmosphere, use of a stopcock shown in any of Figs. 1 - 23D in a monitoring set reduces both the risk of contamination and the need for extra covers or plugs and provides for both flushing of the internal volume of the stopcock and the internal volume of the valve and for increasing the fluid flow rate through the stopcock.

[0190] For routine use in arterial lines, the stopcock is employed in a position such as that shown in Figs. 19A and any of Figs. 20A, 21A, 22A or 22A, where the fluid flows from the arterial line to the patient without making contact with the elastomeric element 114 of the valve.

[0191] To draw blood from the patient, the operator places the handle of the stopcock in the operative orientation shown in Figs. 19B and any of Figs. 20B, 21B, 22B or23B, introduces a syringe to the valve, thereby opening it, and draws blood.

[0192] After blood is drawn, residual blood remains in the internal volumes of the valve and the side port of the stopcock. This residual blood, if not removed from the stopcock, may cause damage to the patient as discussed hereinabove with reference to Figs. 19C and any of Figs. 20C, 21C, 22C and 23C.

[0193] In order to clear the residual blood from the internal volumes, the operator places the handle of the stopcock in the operative orientation shown in Figs. 19C and any of Figs. 20C, 21C, 22C and 23C. In this orientation, the flow of liquid in the arterial line flushes the internal volumes of both the valve and the side port of the stopcock and clears the residual blood therefrom.

[0194] For use of the stopcock in monitoring the arterial blood pressure of the patient, the flow of liquid must not come in contact with the elastomeric component of the valve. Therefore, when the operator has removed the residual blood from the internal volumes of the valve and the side port of the stopcock, he would again place the handle of the stopcock in the operative orientations seen in Figs. 19A and any of Figs. 20A, 21A, 22A or 22B.

[0195] It is appreciated that the stopcock structure shown and described hereinabove may have many advantageous uses in addition to those described specifically hereinabove.

[0196] It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described hereinabove. Rather the scope of the present invention is defined by the appended claims.

Claims

1. A stopcock comprising:

a housing element (100) defining a central bore (119) and at least first, second and third ports (104, 106, 108), and

a handle element (410), which is selectably positionable relative to said housing element,

said housing element and said handle element being arrangeable in multiple mutual positions,

at least one of said housing element and said handle element defining a first fluid flow passageway communicating between two of said at least first, second and third ports, and a second fluid flow passageway communicating between at least two of said at least first, second and third ports, selection of said ports being in accordance with a relative position of said handle element relative to said housing element;

said first fluid flow passageway including a side-to-side extending bore (452) extending through said handle element (410), and said second fluid flow passageway including a first fluid flow guide (454) defined by the handle element (410), and a second fluid flow guide (128) extending radially and partially bifurcating one of said at least one of the first, second and third ports, said second fluid flow guide being associated with at least one of said first fluid flow passageway and said second fluid flow passageway, **characterized in that** said first fluid flow passageway is fluidly isolated from said second fluid flow passageway in at least one of said mutual positions.

2. The stopcock according to claim 1 and wherein said first fluid flow guide (454) extends radially towards an inner facing wall of said central bore (119) and partially bifurcates said second fluid flow passageway.

3. The stopcock according to any of claims 1-2 and wherein said first fluid flow passageway and said second fluid flow passageway are operative simultaneously in at least one of said multiple mutual positions.

4. The stopcock according to any of claims 1-3 and wherein said second fluid flow passageway being configured for enabling flushing an internal volume of at least one of said first, second and third ports (104, 106, 108) by a fluid flow which does not flow entirely through said port whose internal volume is being flushed, and

said first fluid flow passageway being configured for increasing a fluid flow rate between two of said at least first, second and third ports (104, 106, 108).

5. The stopcock according to any of claims 1-4 and wherein said first fluid flow guide (454) comprising an outward facing edge (456) which sealingly engages an inner facing wall of said central bore (119), and when said outward facing edge (456) of said first fluid flow guide (454) is not located opposite any of said first, second and third ports (104, 106, 108), flow of liquid through said second fluid flow passageway is prevented and flow of liquid through said first fluid flow passageway is allowed.

6. The stopcock according to claims 1-5 and also comprising at least one valve (114), which is associated with at least one of said first, second and third ports (104, 106, 108).

7. The stopcock according to claim 6 and wherein said valve (114) includes an elastomeric element, and wherein at least one of said first fluid flow passageway and said second fluid flow passageway is configured for providing a fluid flow which is sealed from said elastomeric element when said housing element (100) and said handle element (410) are in another one of said mutual positions.

8. The stopcock according to any of claims 1 - 7 and

wherein said at least one side-to-side extending bore (452) has a semi-circular cross-section.

9. The stopcock according to any of claims 1 - 8 and wherein said handle element (410) has a partially peripherally-extending recess (453), selectably defining said second fluid flow passageway, said first fluid flow guide (454) extending radially and partially bifurcating said recess (453).

10. The stopcock according to claim 9 and wherein said at least one side-to-side extending bore (452) is spaced from said recess (453).

11. The stopcock according to any of claims 1 - 10 and wherein said first fluid flow passageway is fluidly connected with said second fluid flow passageway in other of said at least one of said mutual positions.

Patentansprüche

1. Absperrhahn, umfassend:

ein Gehäuseelement (100), das eine zentrale Bohrung (119) und mindestens einen ersten, zweiten und dritten Anschluss (104, 106, 108) definiert, und ein Griffelement (410), das bezogen auf das Gehäuseelement wählbar positionierbar ist,
wobei das Gehäuseelement und das Griffelement in mehreren gegenseitigen Positionen anordenbar sind,
wobei mindestens eines von dem Gehäuseelement und dem Griffelement Folgendes definiert:
einen ersten Fluidströmungsdurchgang, der zwischen zwei des mindestens ersten, zweiten und dritten Anschlusses kommuniziert, und einen zweiten Fluidströmungsdurchgang, der zwischen mindestens zwei des mindestens ersten, zweiten und dritten Anschlusses kommuniziert, wobei die Auswahl der Anschlüsse einer relativen Position des Griffelements bezogen auf das Gehäuseelement entspricht;
wobei der erste Fluidströmungsdurchgang eine sich seitlich erstreckende Bohrung (452) beinhaltet, die sich durch das Griffelement (410) erstreckt,
und der zweite Fluidströmungsdurchgang eine erste Fluidströmungsführung (454) beinhaltet, die durch das Griffelement (410) definiert ist, und
eine zweite Fluidströmungsführung (128), die sich radial erstreckt und einen des mindestens einen des ersten, zweiten und dritten Anschlusses teilweise gabelt, wobei die zweite Fluidströmungsführung mindestens einem von dem ersten Fluidströmungsdurchgang und dem zweiten Fluidströmungsdurchgang zugeordnet ist, **dadurch gekennzeichnet, dass** der erste Fluidströmungsdurchgang in mindestens einer der gegenseitigen Positionen fluidisch von dem zweiten Fluidströmungsdurchgang isoliert ist.

2. Absperrhahn nach Anspruch 1, wobei sich die erste Fluidströmungsführung (454) radial in Richtung einer nach innen gerichteten Wand der zentralen Bohrung (119) erstreckt und den zweiten Fluidströmungsdurchgang teilweise gabelt.

3. Absperrhahn nach einem der Ansprüche 1 - 2, wobei der erste Fluidströmungsdurchgang und der zweite Fluidströmungsdurchgang in mindestens einer der mehreren gegenseitigen Positionen gleichzeitig funktionsfähig sind.

4. Absperrhahn nach einem der Ansprüche 1 - 3, wobei der zweite Fluidströmungsdurchgang dazu konfiguriert ist, ein Spülen eines Innenvolumens von mindestens einem des ersten, zweiten und dritten Anschlusses (104, 106, 108) durch eine Fluidströmung zu ermöglichen, die nicht vollständig durch den Anschluss fließt, dessen Innenvolumen gespült wird, und
wobei der erste Fluidströmungsdurchgang dazu konfiguriert ist, eine Fluidströmungsrate zwischen zwei des mindestens ersten, zweiten und dritten Anschlusses (104, 106, 108) zu erhöhen.

5. Absperrhahn nach einem der Ansprüche 1 - 4, wobei die erste Fluidströmungsführung (454) eine nach außen gerichtete Kante (456) umfasst, die dichtend in eine nach innen gerichtete Wand der zentralen Bohrung (119) eingreift, und wobei, wenn sich die nach außen gerichtete Kante (456) der ersten Fluidströmungsführung (454) nicht gegenüber eines beliebigen des ersten, zweiten und dritten Anschlusses (104, 106, 108) befindet, eine Flüssigkeitsströmung durch den zweiten Fluidströmungsdurchgang verhindert wird und eine Flüssigkeitsströmung durch den ersten Fluidströmungsdurchgang zugelassen wird.

6. Absperrhahn nach den Ansprüchen 1 - 5, außerdem umfassend mindestens ein Ventil (114), das mindestens einem des ersten, zweiten und dritten Anschlusses (104, 106, 108) zugeordnet ist.

7. Absperrhahn nach Anspruch 6, wobei das Ventil (114) ein Elastomerelement beinhaltet und wobei mindestens einer von dem ersten Fluidströmungsdurchgang und zweiten Fluidströmungsdurchgang dazu konfiguriert ist, eine Fluidströmung bereitzustellen, die gegenüber dem Elastomerelement abgedichtet ist, wenn sich das Gehäuseelement (100) und das Griffelement (410) in einer anderen der ge-

genseitigen Positionen befinden.

8. Absperrhahn nach einem der Ansprüche 1 - 7, wobei die mindestens eine sich seitlich erstreckende Bohrung (452) einen halbkreisförmigen Querschnitt aufweist.

9. Absperrhahn nach einem der Ansprüche 1 - 8, wobei das Griffelement (410) eine sich teilweise peripher erstreckende Aussparung (453) aufweist, die wählbar den zweiten Fluidströmungsdurchgang definiert, wobei die erste Fluidströmungsführung (454) sich radial erstreckt und die Aussparung (453) teilweise gabelt.

10. Absperrhahn nach Anspruch 9, wobei die mindestens eine sich seitlich erstreckende Bohrung (452) von der Aussparung (453) beabstandet ist.

11. Absperrhahn nach einem der Ansprüche 1 - 10, wobei der erste Fluidströmungsdurchgang in einer anderen der mindestens einen der gegenseitigen Positionen fluidisch mit dem zweiten Fluidströmungsdurchgang verbunden ist.

Revendications

1. Robinet d'arrêt comprenant :

un élément de corps (100) définissant un alésage central (119) et au moins des premier, deuxième et troisième orifices (104, 106, 108), et
un élément de poignée (410), qui peut être positionné de manière sélective par rapport audit élément de corps,
ledit élément de corps et ledit élément de poignée pouvant être disposés dans de multiples positions mutuelles,
au moins l'un parmi ledit élément de boîtier et ledit élément de poignée définissant un premier passage d'écoulement de fluide communiquant entre deux desdits au moins premier, deuxième et troisième orifices, et un second passage d'écoulement de fluide communiquant entre au moins deux desdits au moins premier, deuxième et troisième orifices, la sélection desdits orifices étant conforme à une position relative dudit élément de poignée par rapport audit élément de corps ;
ledit premier passage d'écoulement de fluide comprenant un alésage (452) s'étendant d'un côté à l'autre s'étendant à travers ledit élément de poignée (410),
et ledit second passage d'écoulement de fluide comprenant un premier guide d'écoulement de fluide (454) défini par l'élément de poignée (410), et
un second guide d'écoulement de fluide (128) s'étendant radialement et faisant bifurquer partiellement l'un desdits au moins l'un des premier, deuxième et troisième orifices, ledit second guide d'écoulement de fluide étant associé à au moins l'un parmi ledit premier passage d'écoulement de fluide et ledit second passage d'écoulement de fluide, **caractérisé en ce que** ledit premier passage d'écoulement de fluide est fluidiquement isolé dudit second passage d'écoulement de fluide dans au moins l'une desdites positions mutuelles.

2. Robinet d'arrêt selon la revendication 1 et ledit premier guide d'écoulement de fluide (454) s'étendant radialement vers une paroi tournée vers l'intérieur dudit alésage central (119) et faisant bifurquer partiellement ledit second passage d'écoulement de fluide.

3. Robinet d'arrêt selon l'une quelconque des revendications 1 à 2 et ledit premier passage d'écoulement de fluide et ledit second passage d'écoulement de fluide fonctionnant simultanément dans au moins l'une desdites multiples positions mutuelles.

4. Robinet d'arrêt selon l'une quelconque des revendications 1 à 3 et ledit second passage d'écoulement de fluide étant conçu pour permettre le rinçage d'un volume interne d'au moins l'un desdits premier, deuxième et troisième orifices (104, 106, 108) par un écoulement de fluide qui ne s'écoule pas entièrement à travers ledit orifice dont le volume interne est en cours de rinçage, et
ledit premier passage d'écoulement de fluide étant conçu pour augmenter un débit de fluide entre deux desdits au moins premier, deuxième et troisième orifices (104, 106, 108).

5. Robinet d'arrêt selon l'une quelconque des revendications 1 à 4 et ledit guide d'écoulement de fluide (454) comprenant un bord (456) orienté vers l'extérieur qui vient en prise de manière étanche avec une paroi orientée vers l'intérieur dudit alésage central (119), et lorsque ledit bord (456) orienté vers l'extérieur dudit premier guide d'écoulement de fluide (454) n'est pas situé en face de l'un quelconque desdits premier, deuxième et troisième orifices (104, 106, 108), ledit écoulement de liquide à travers ledit second passage d'écoulement de fluide étant empêché et ledit écoulement de liquide à travers ledit premier passage d'écoulement de fluide étant autorisé.

6. Robinet d'arrêt selon les revendications 1 à 5 et comprenant également au moins une vanne (114), qui est associée à au moins l'un desdits premier, deuxiè-

me et troisième orifices (104, 106, 108).

7. Robinet d'arrêt selon la revendication 6 et ladite vanne (114) comprenant un élément élastomère, et au moins l'un parmi ledit premier passage d'écoulement de fluide et ledit second passage d'écoulement de fluide étant conçu pour fournir un écoulement de fluide qui est isolé dudit élément élastomère lorsque ledit élément de corps (100) et ledit élément de poignée (410) se trouvent dans une autre desdites positions mutuelles.

8. Robinet d'arrêt selon l'une quelconque des revendications 1 à 7 et ledit au moins un alésage (452) s'étendant d'un côté à l'autre possédant une section transversale semi-circulaire.

9. Robinet d'arrêt selon l'une quelconque des revendications 1 à 8 et ledit élément de poignée (410) comportant un évidement (453) s'étendant partiellement de manière périphérique, définissant de manière sélectionnable ledit second passage d'écoulement de fluide, ledit premier guide d'écoulement de fluide (454) s'étendant radialement et faisant bifurquer partiellement ledit évidement (453).

10. Robinet d'arrêt selon la revendication 9 et ledit au moins un alésage (452) s'étendant d'un côté à l'autre étant espacé dudit évidement (453).

11. Robinet d'arrêt selon l'une quelconque des revendications 1 à 10 et ledit premier passage d'écoulement de fluide étant en communication fluidique avec ledit second passage d'écoulement de fluide dans au moins l'une desdites positions mutuelles.

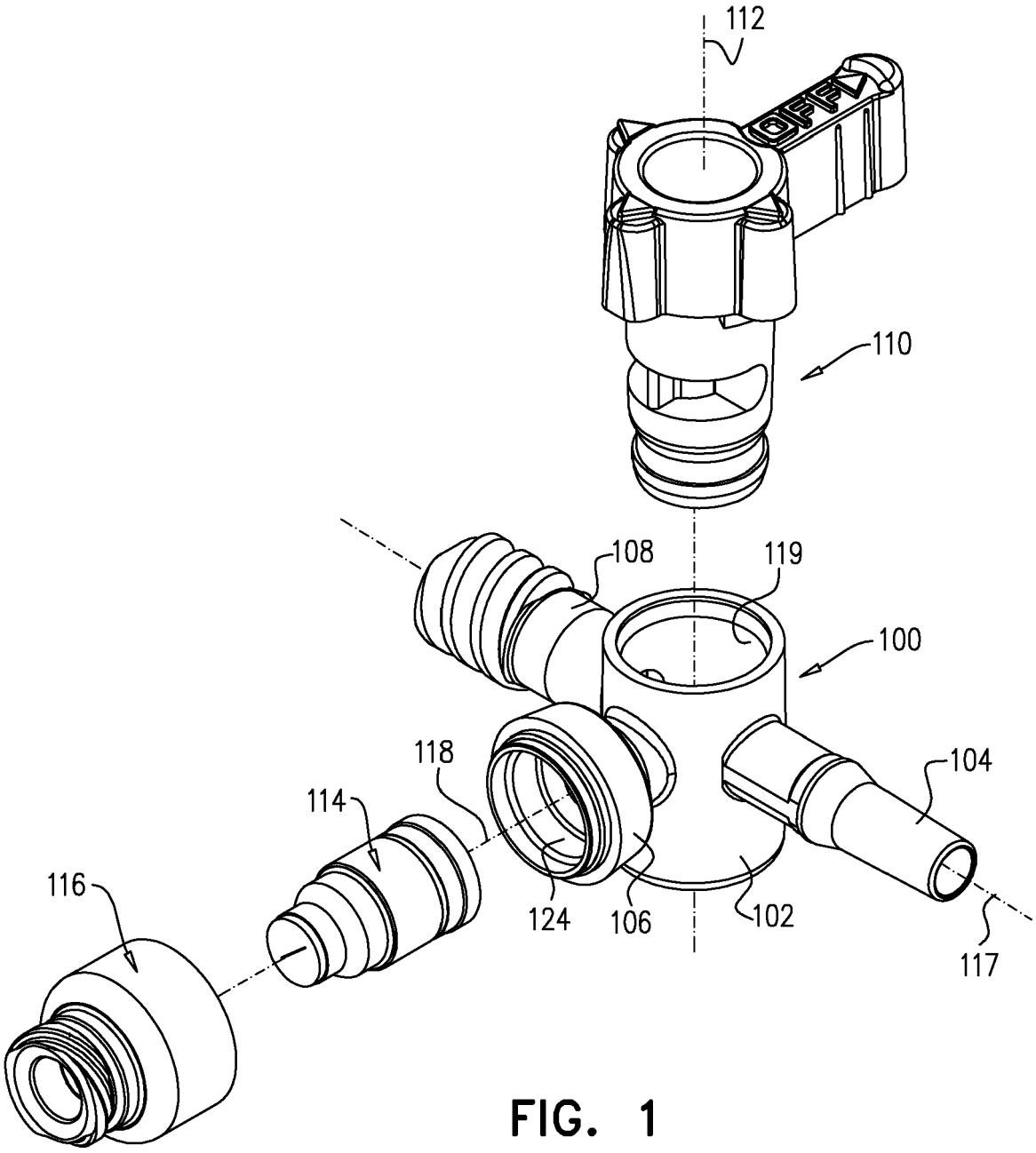


FIG. 1

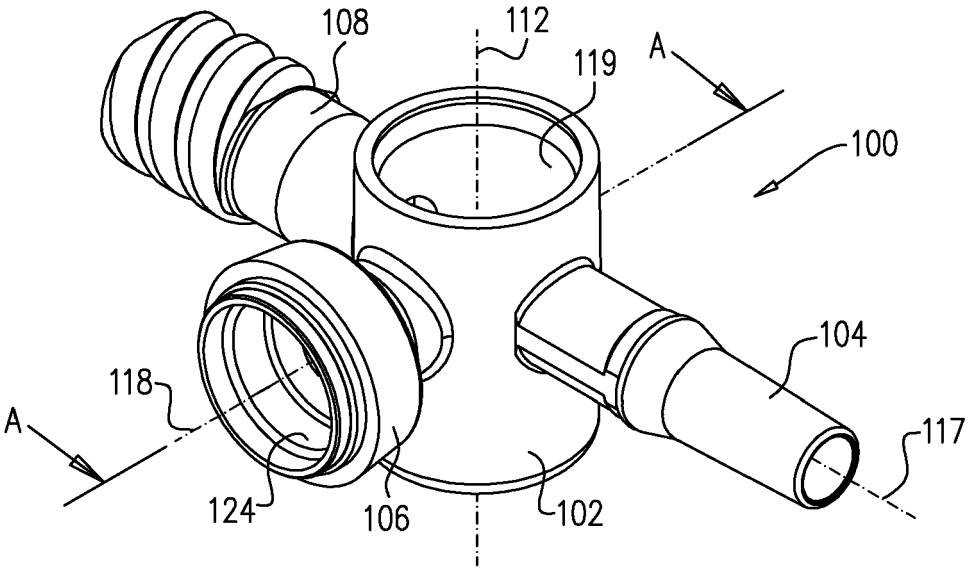
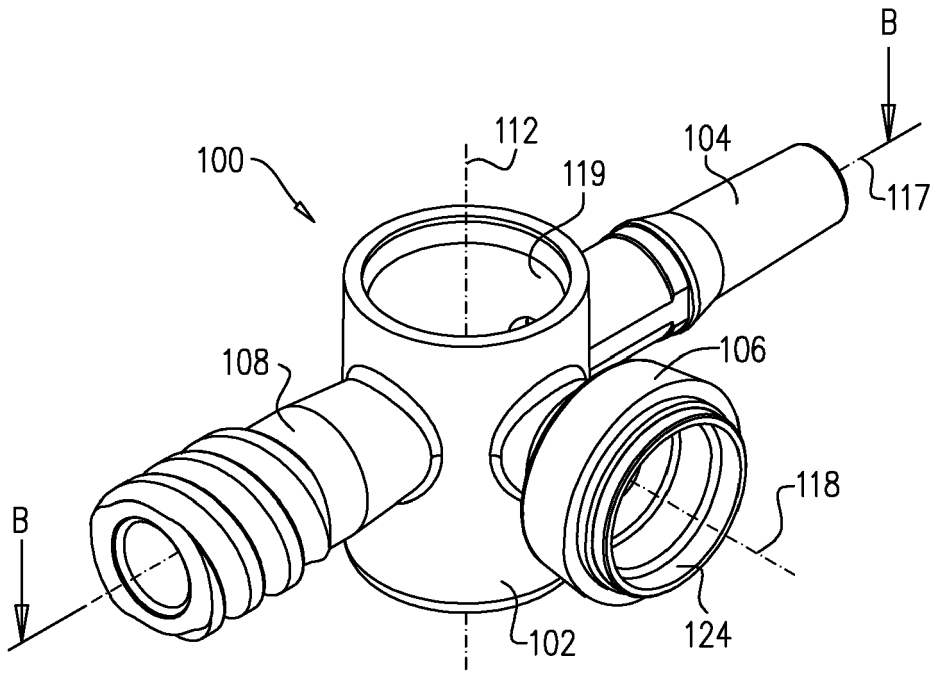

108
112
119
A
100
104
118
A
117
124
106
102

FIG. 2A


B
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104
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119
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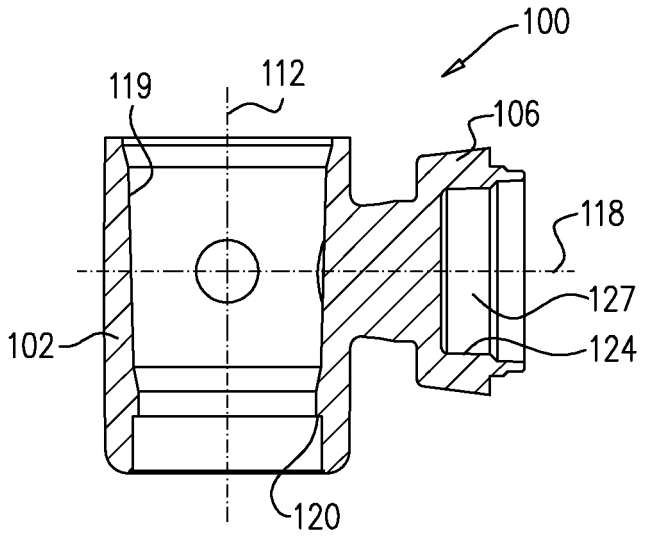
108
106
118
B
102
124

FIG. 2B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112
106
118
127
102
124
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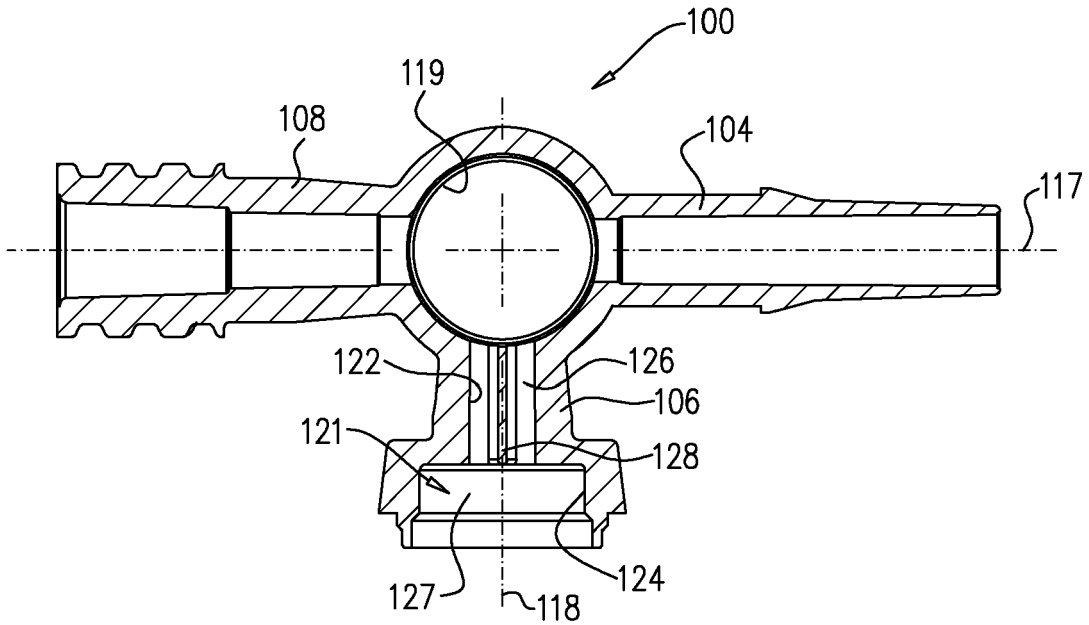
FIG. 3A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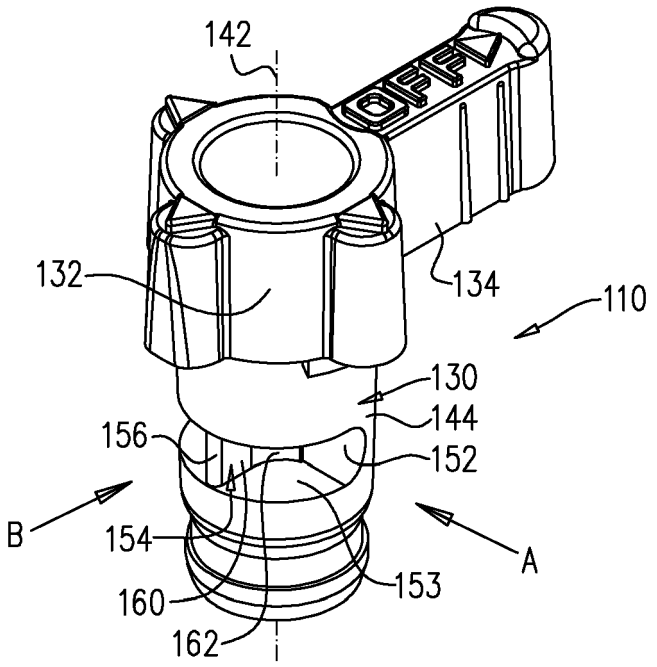
124
118

FIG. 3B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132
134
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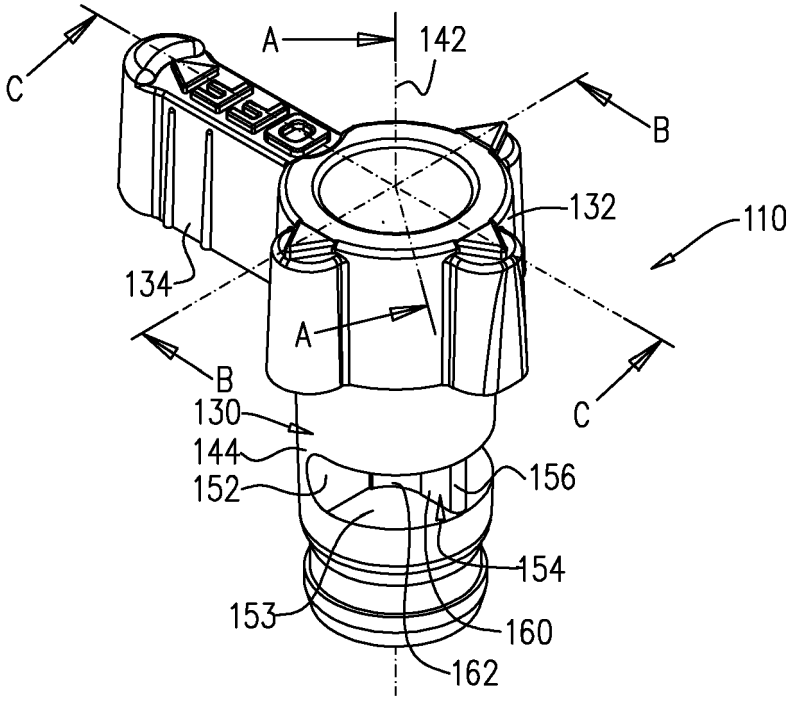
130
144
156
152
A
B
154
A
153
160
162

FIG. 4A


C
A
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A
B
C
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160
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FIG. 4B

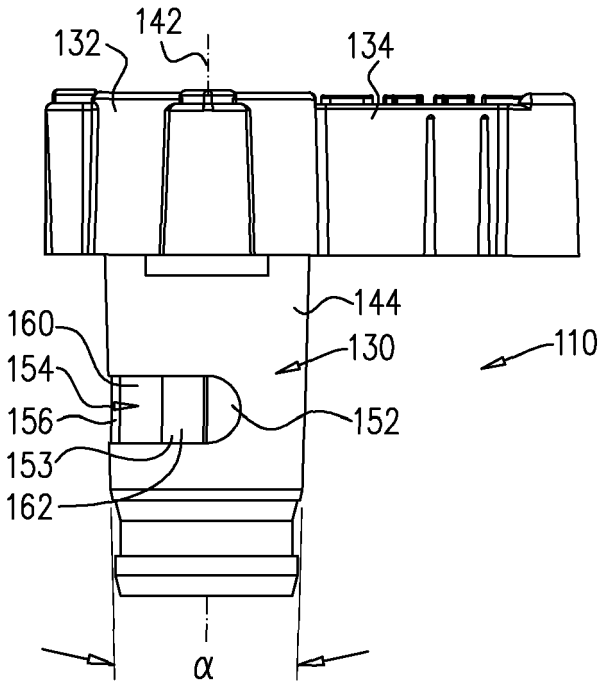
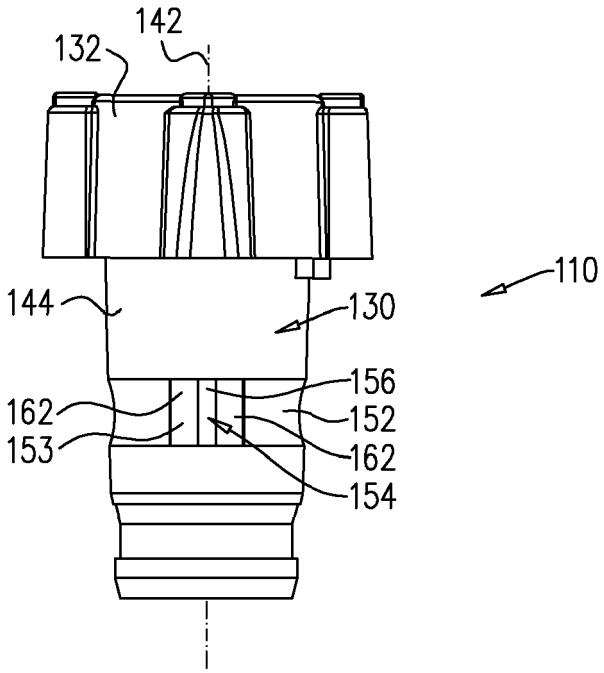

142
132
134
144
160
130
110
154
156
152
153
162
α

FIG. 5A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144
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156
162
152
153
162
154

FIG. 5B

FIG. 6A

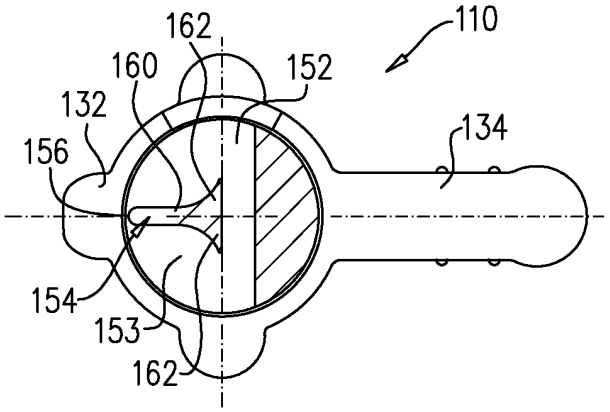


FIG. 6B

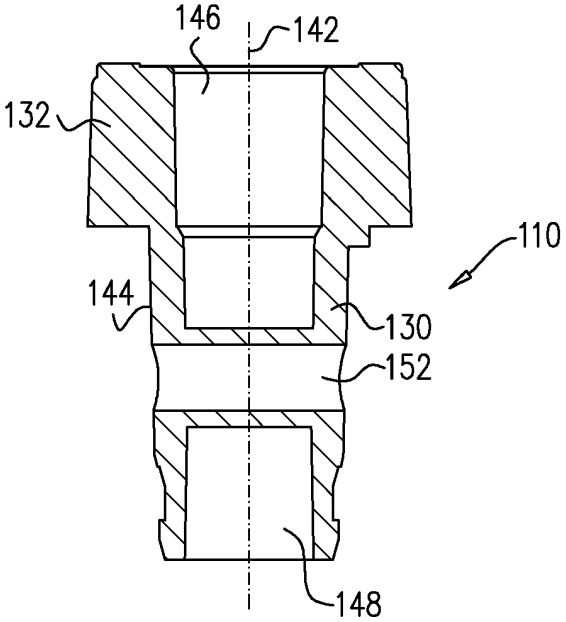
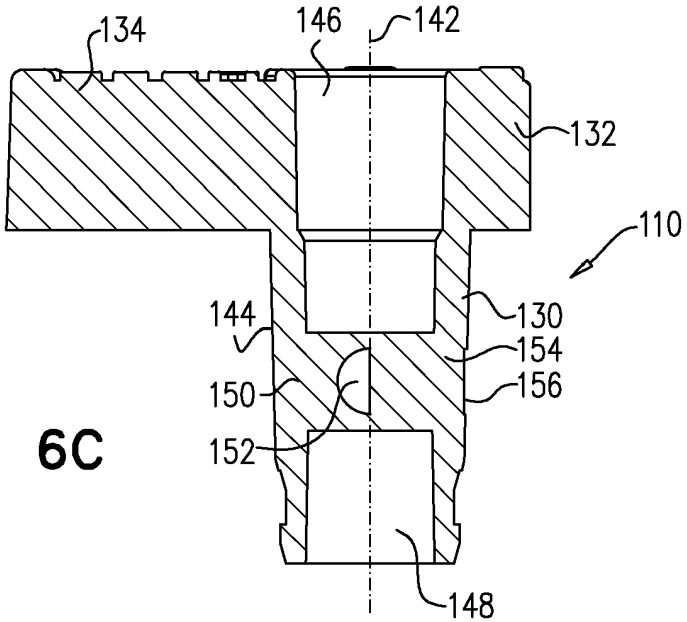


FIG. 6C



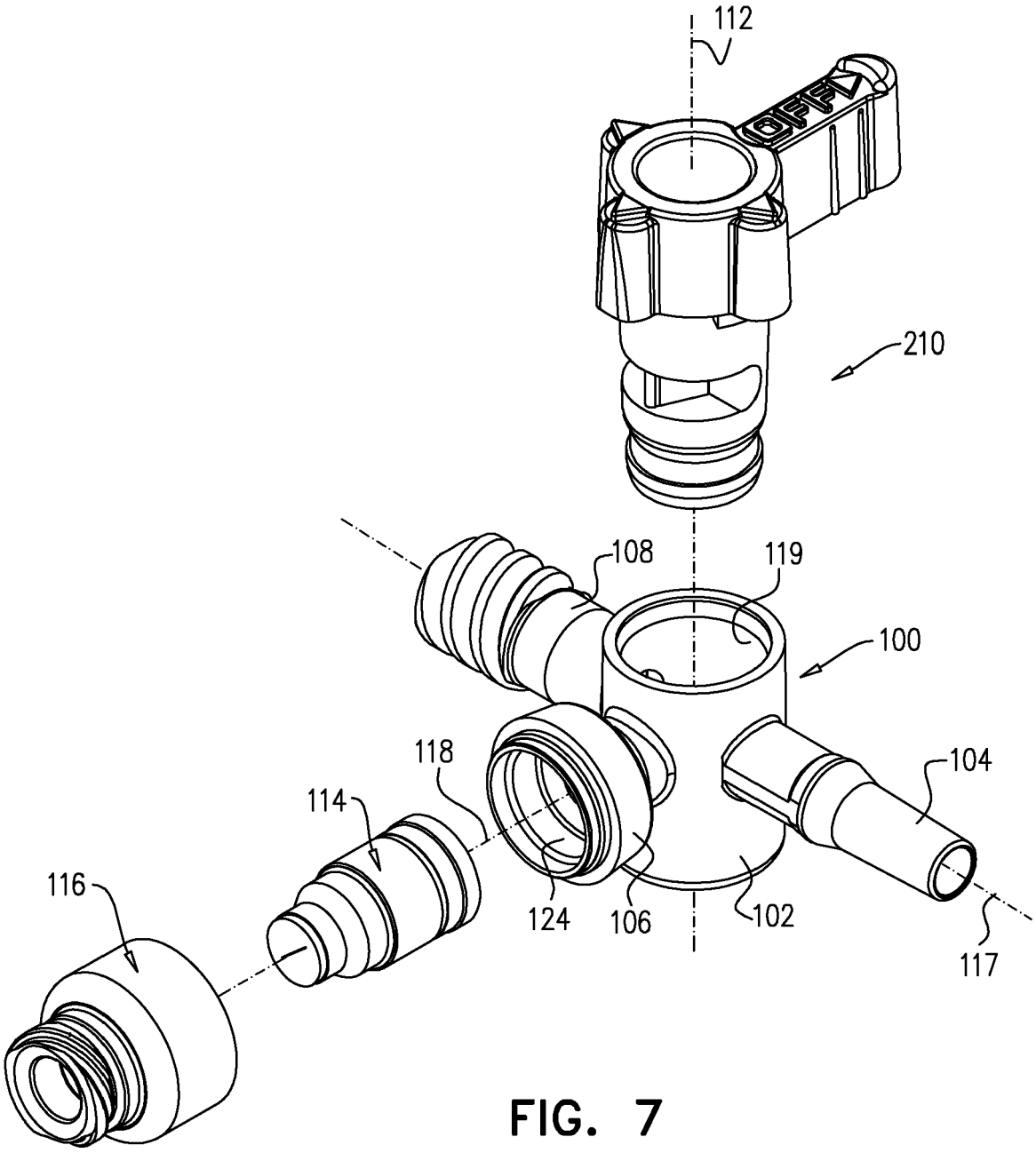
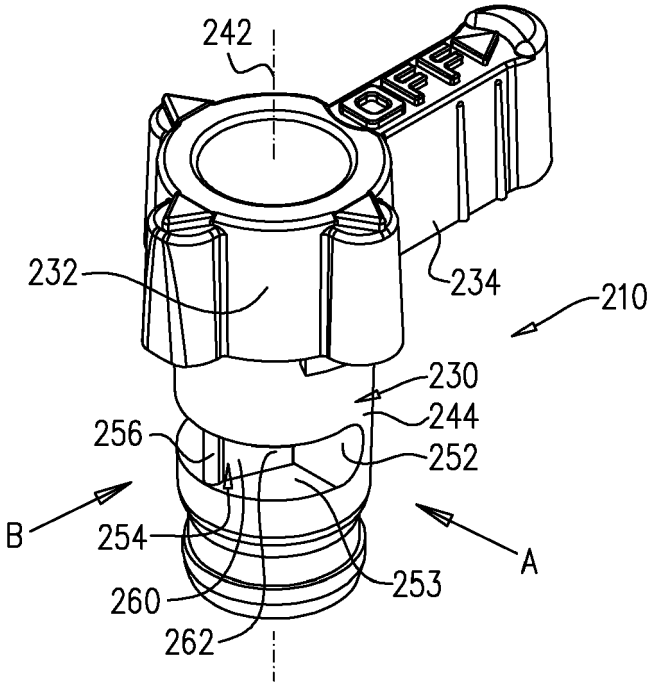


FIG. 7


242
OPEN
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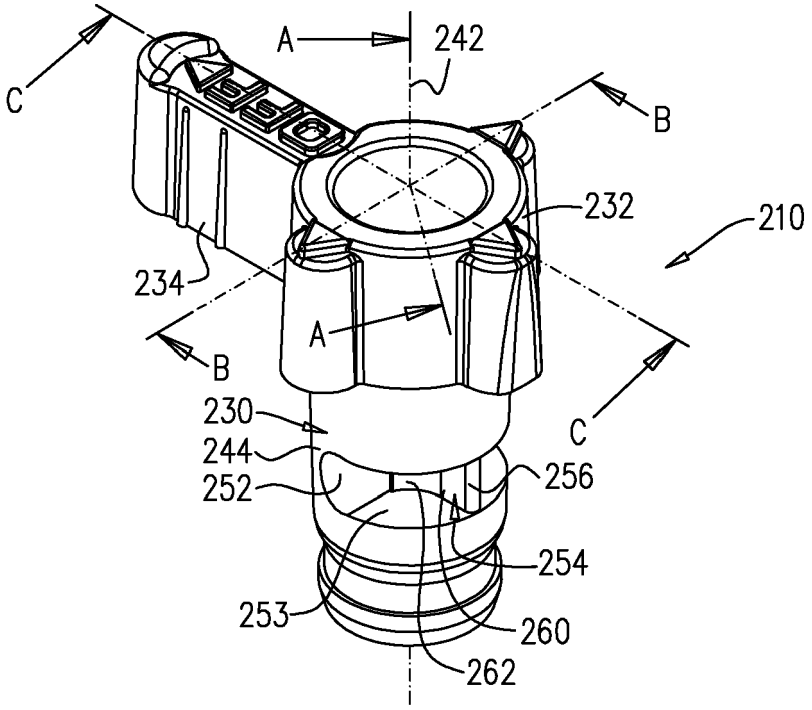
262

FIG. 8A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C
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FIG. 8B

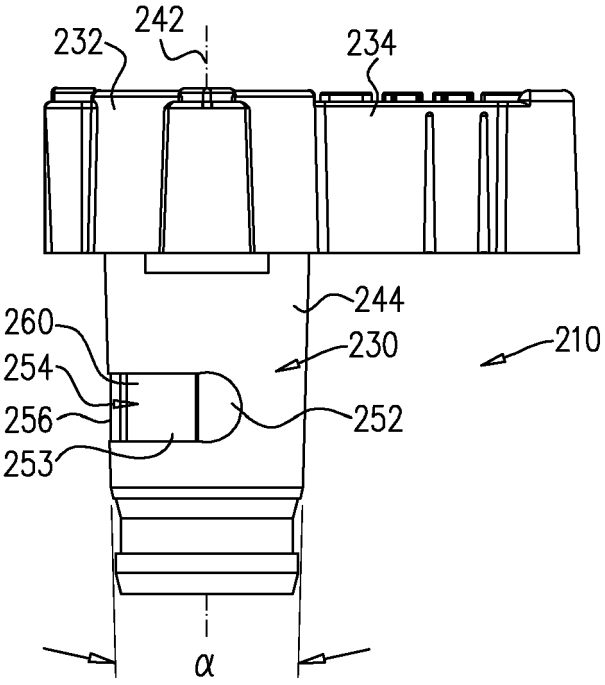
242
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FIG. 9A

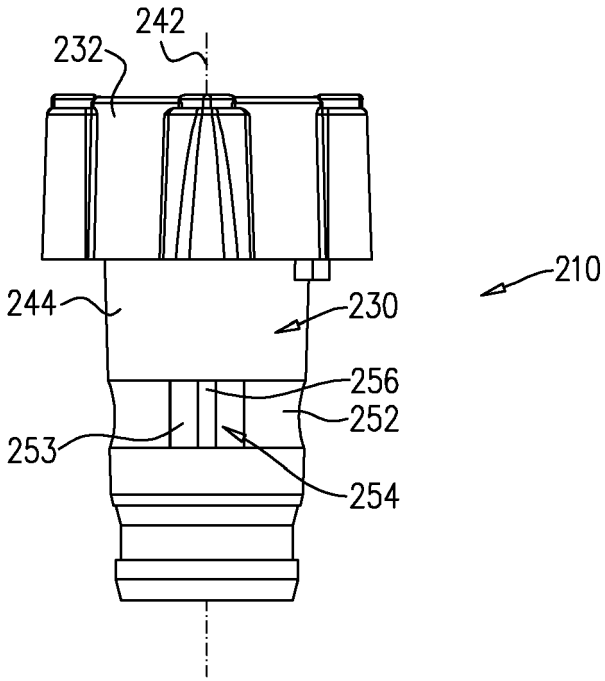
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FIG. 9B

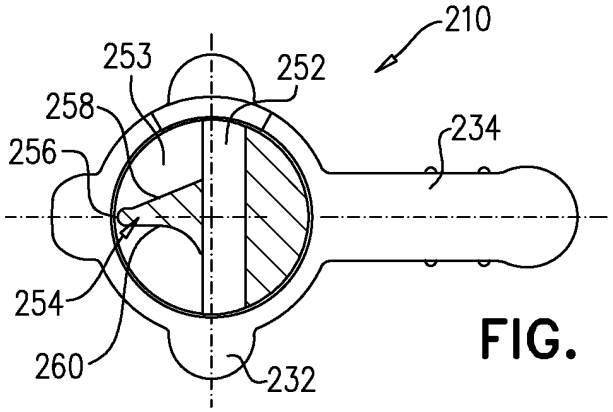


FIG. 10A

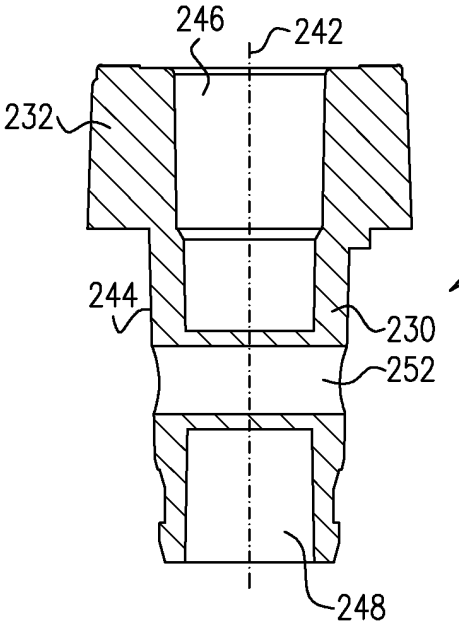


FIG. 10B

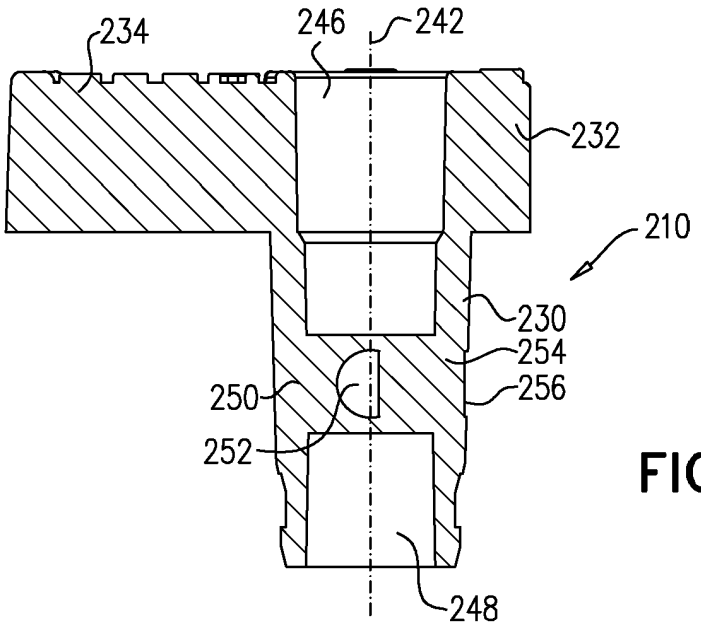


FIG. 10C

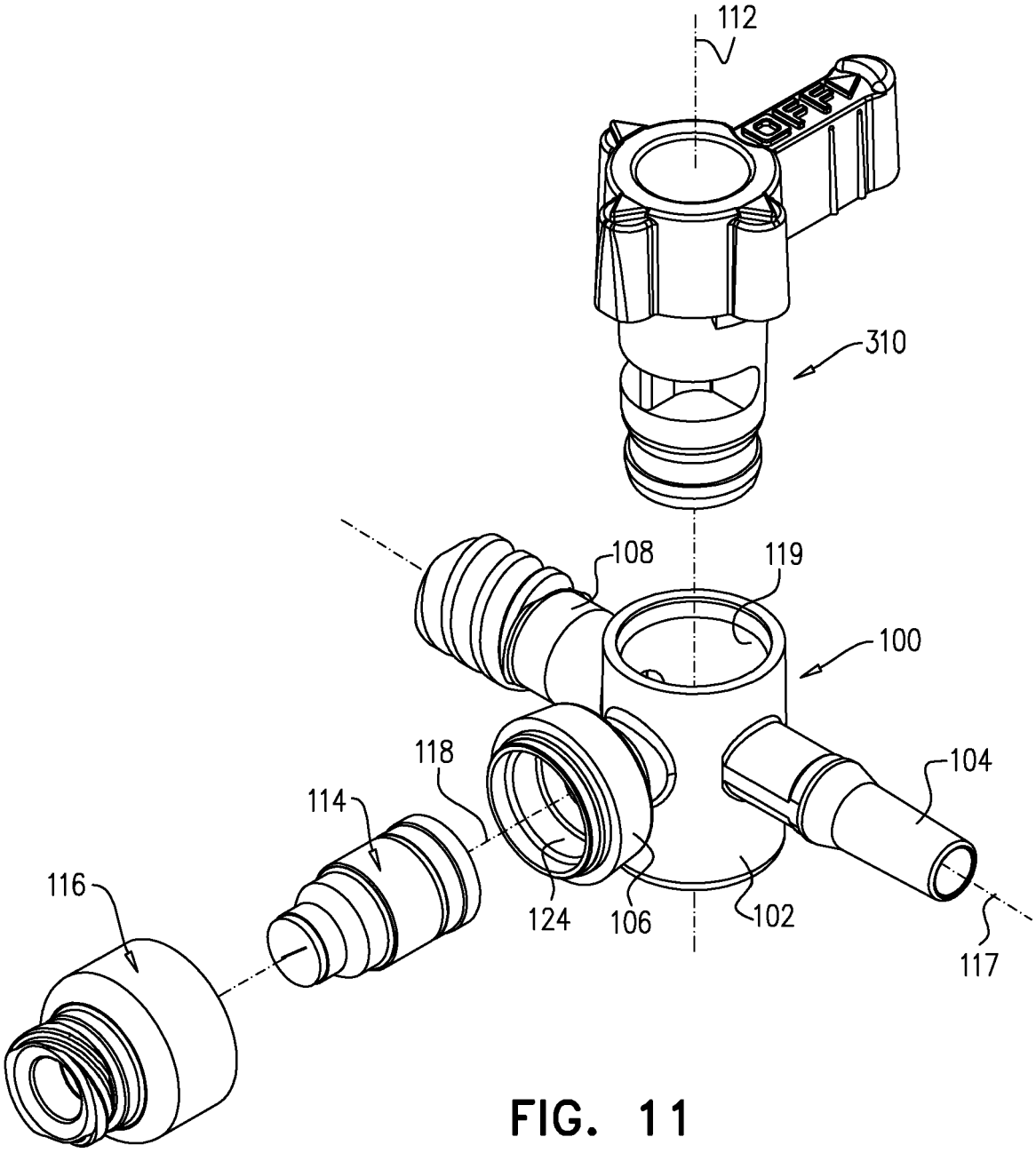


FIG. 11

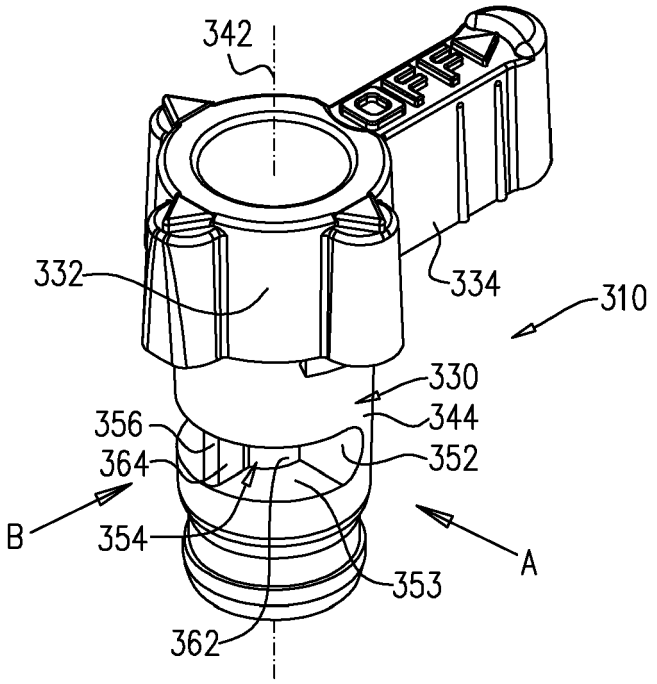


FIG. 12A

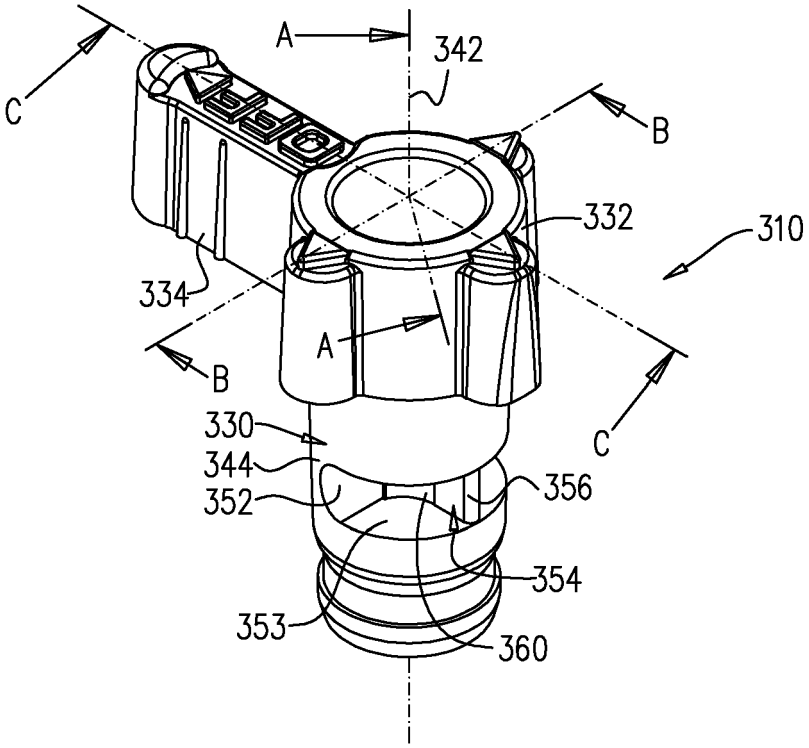


FIG. 12B

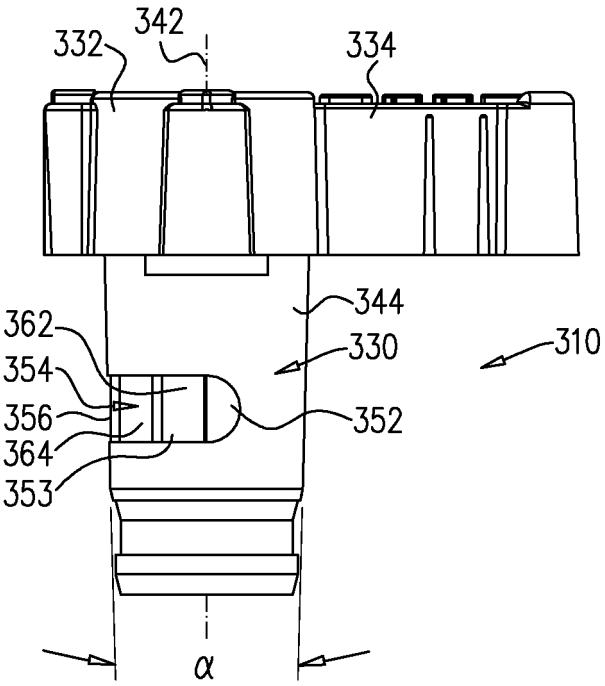


FIG. 13A

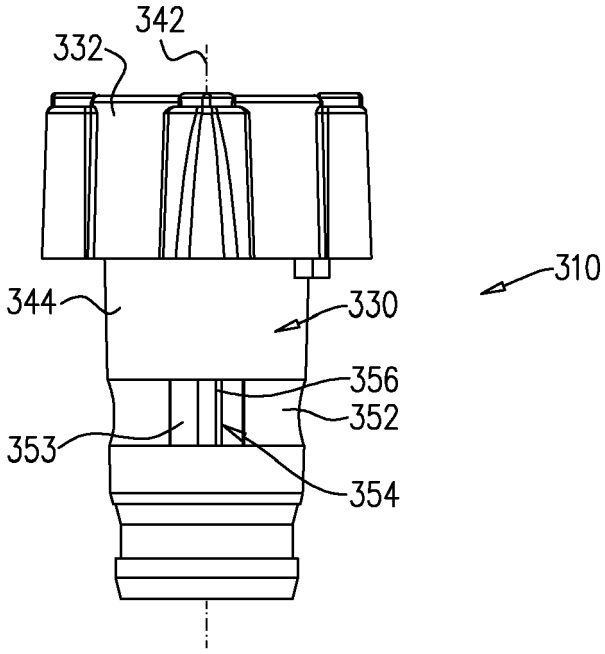


FIG. 13B

FIG. 14A

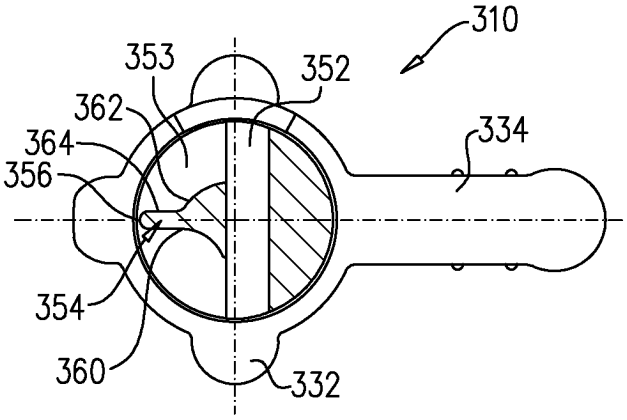


FIG. 14B

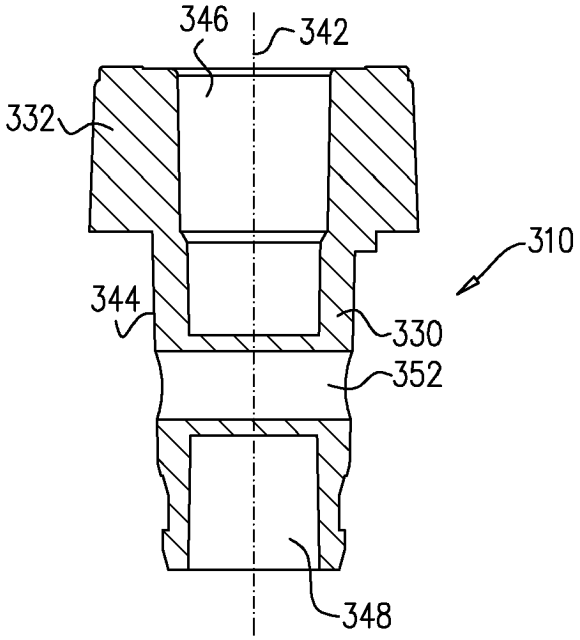
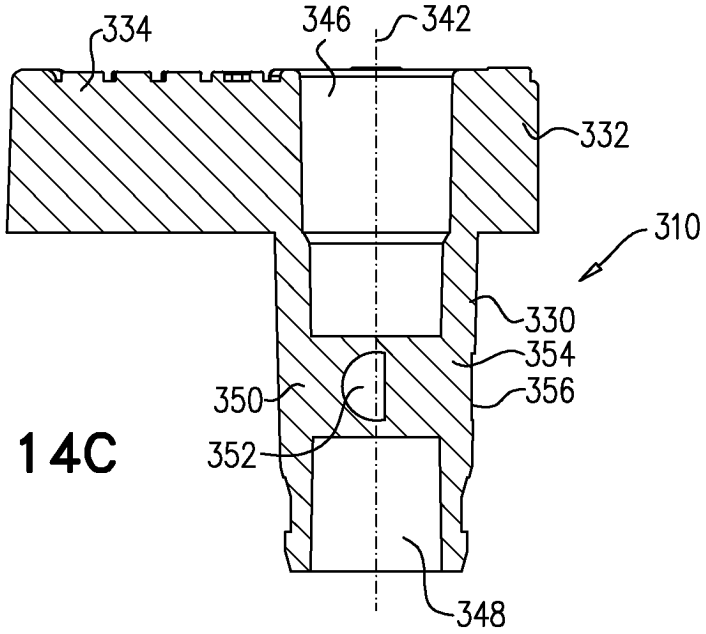


FIG. 14C



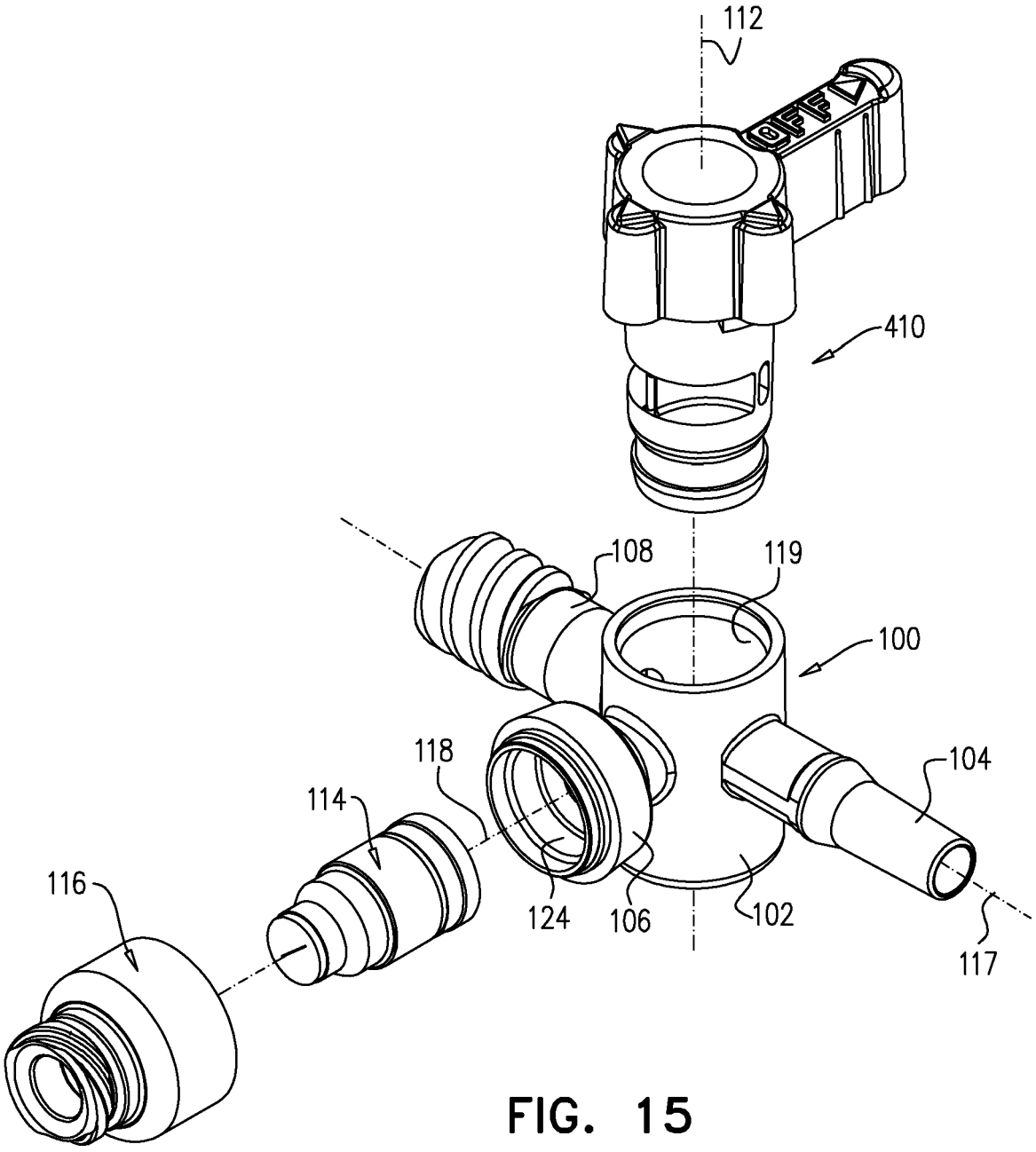


FIG. 15

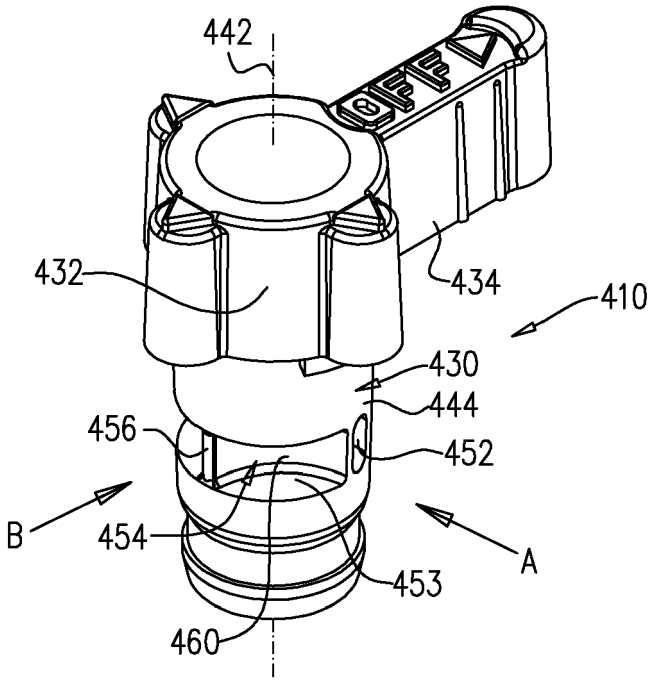


FIG. 16A

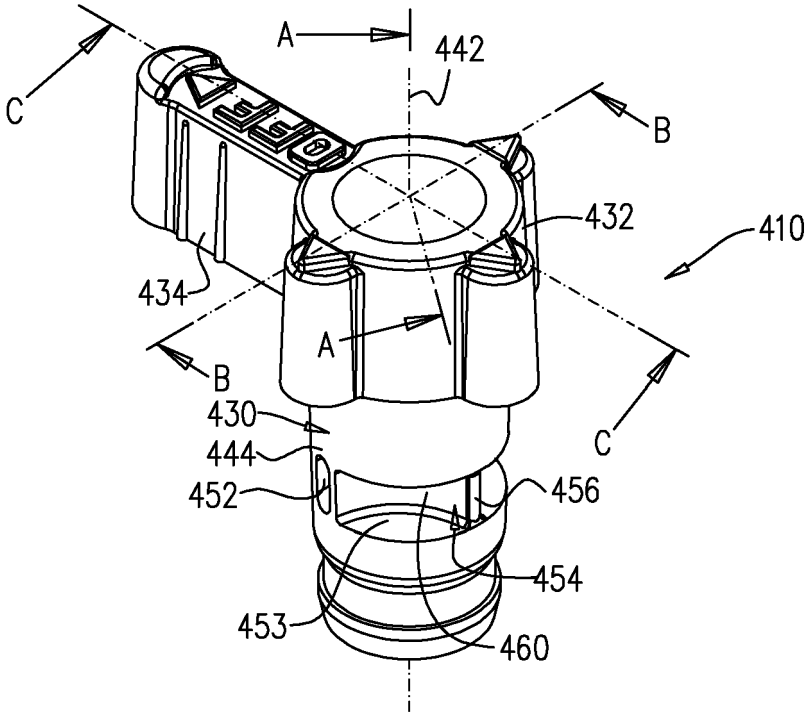


FIG. 16B

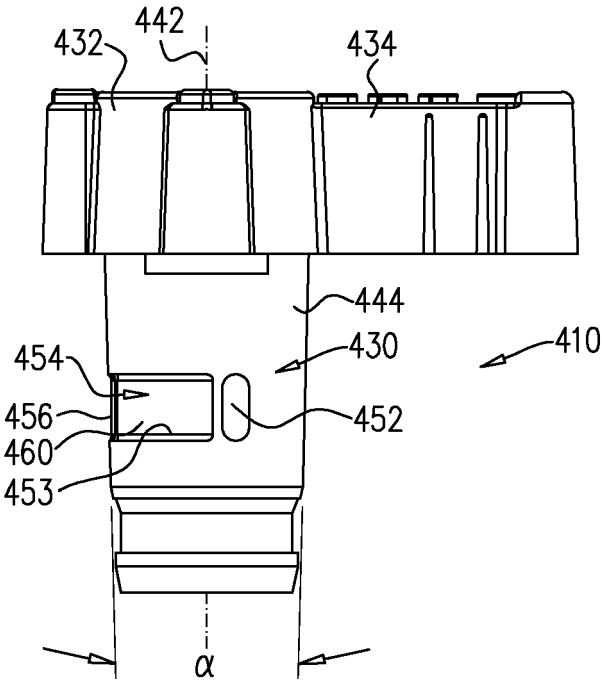


FIG. 17A

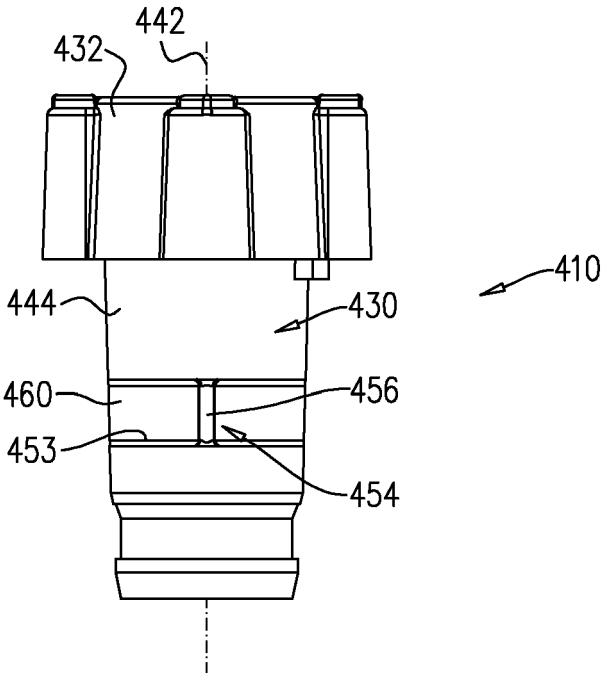


FIG. 17B

FIG. 18A

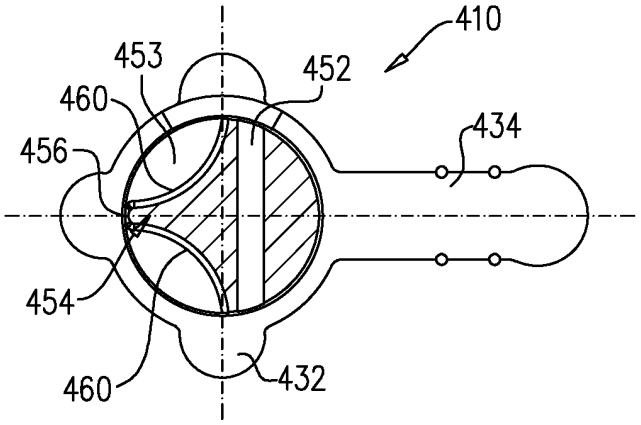


FIG. 18B

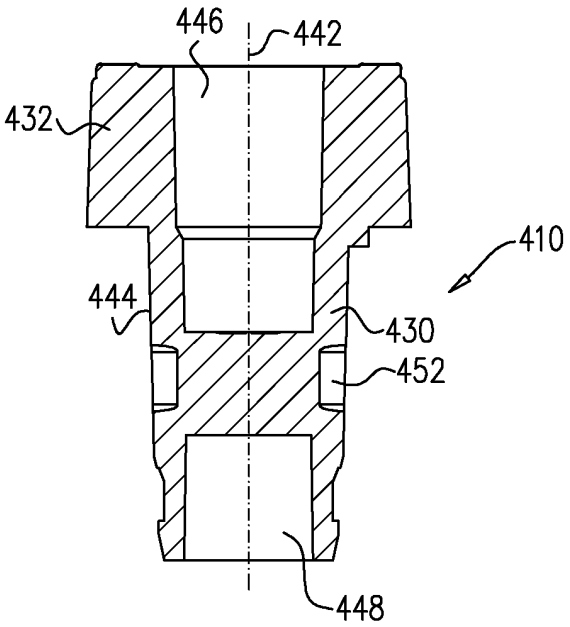
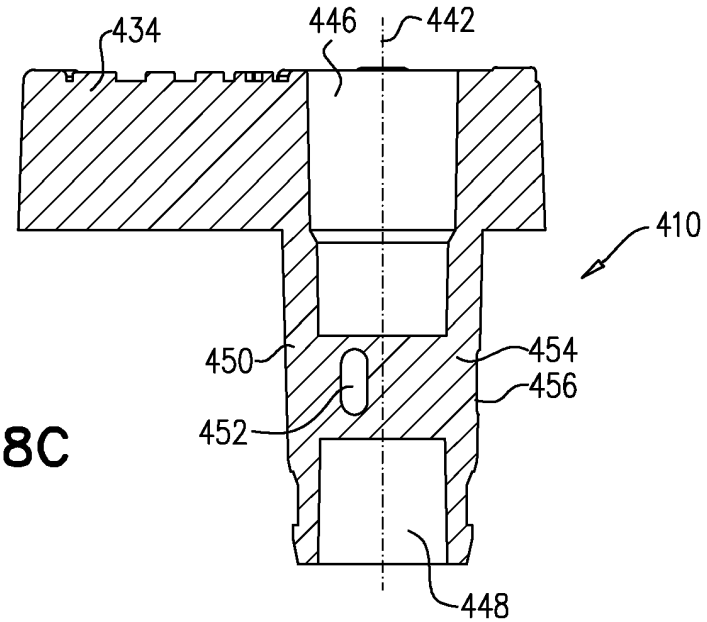


FIG. 18C



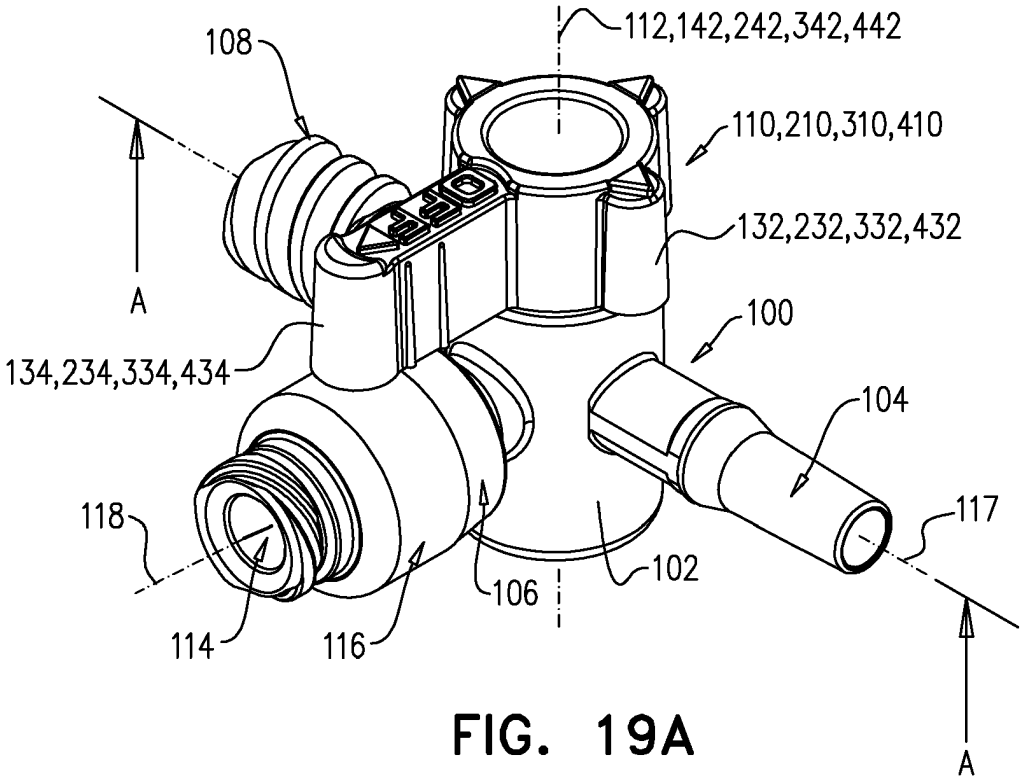


FIG. 19A

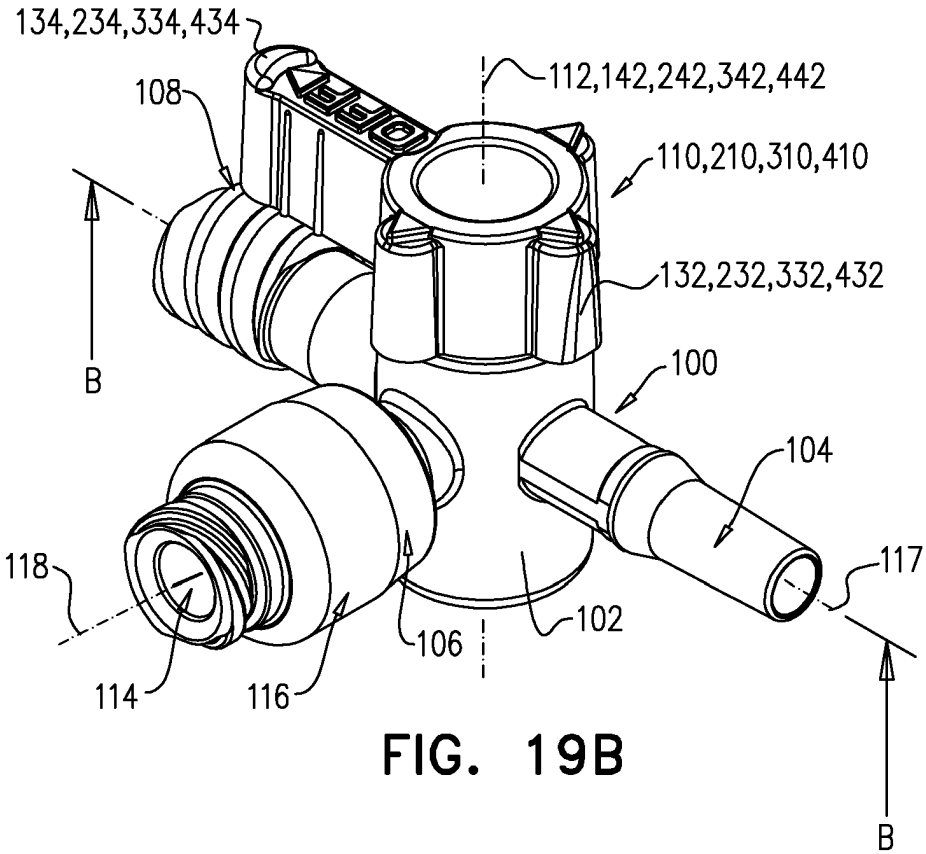


FIG. 19B

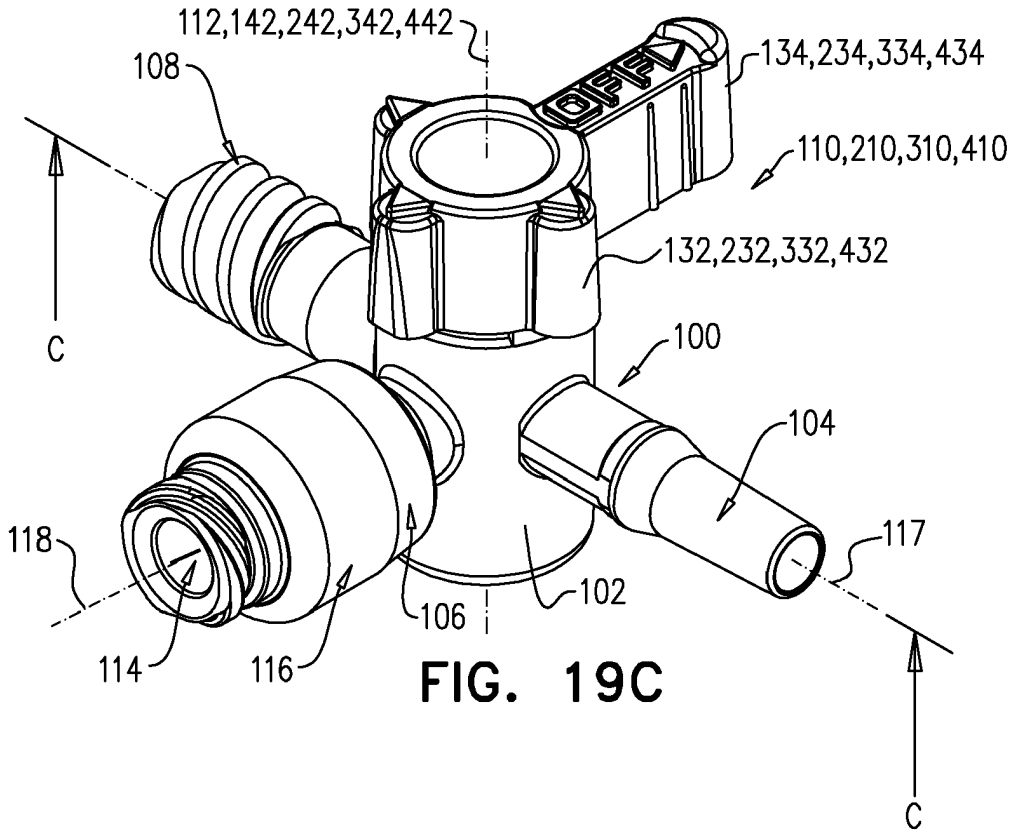


FIG. 19C

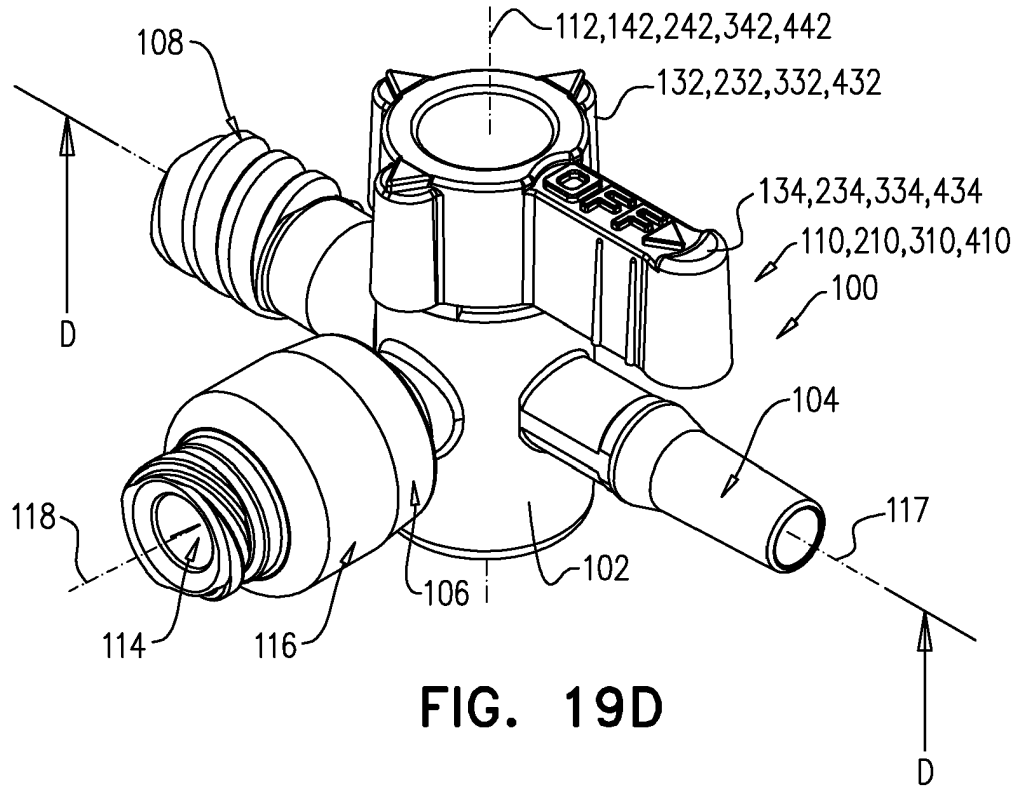


FIG. 19D

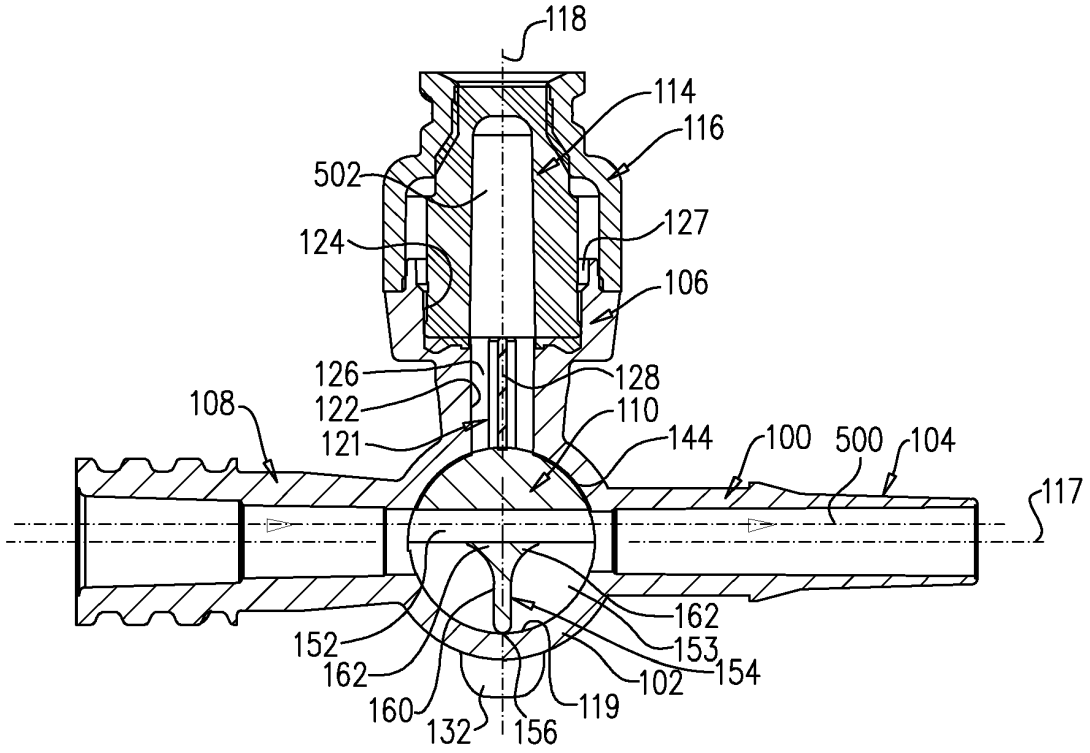


FIG. 20A

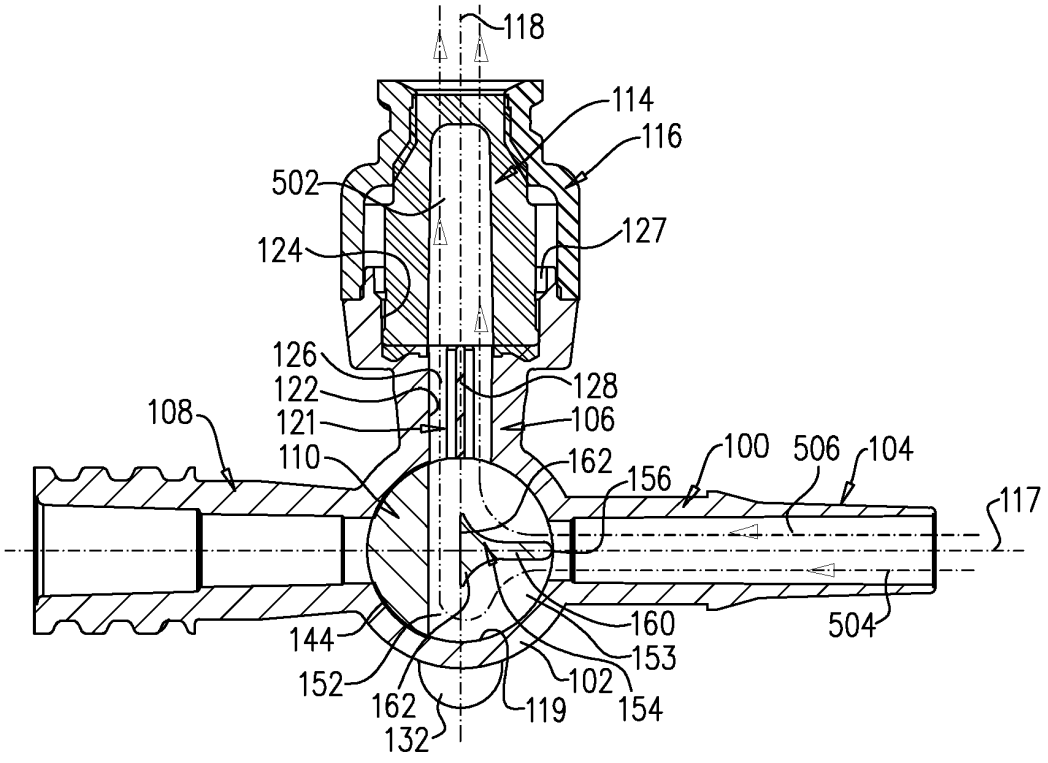


FIG. 20B

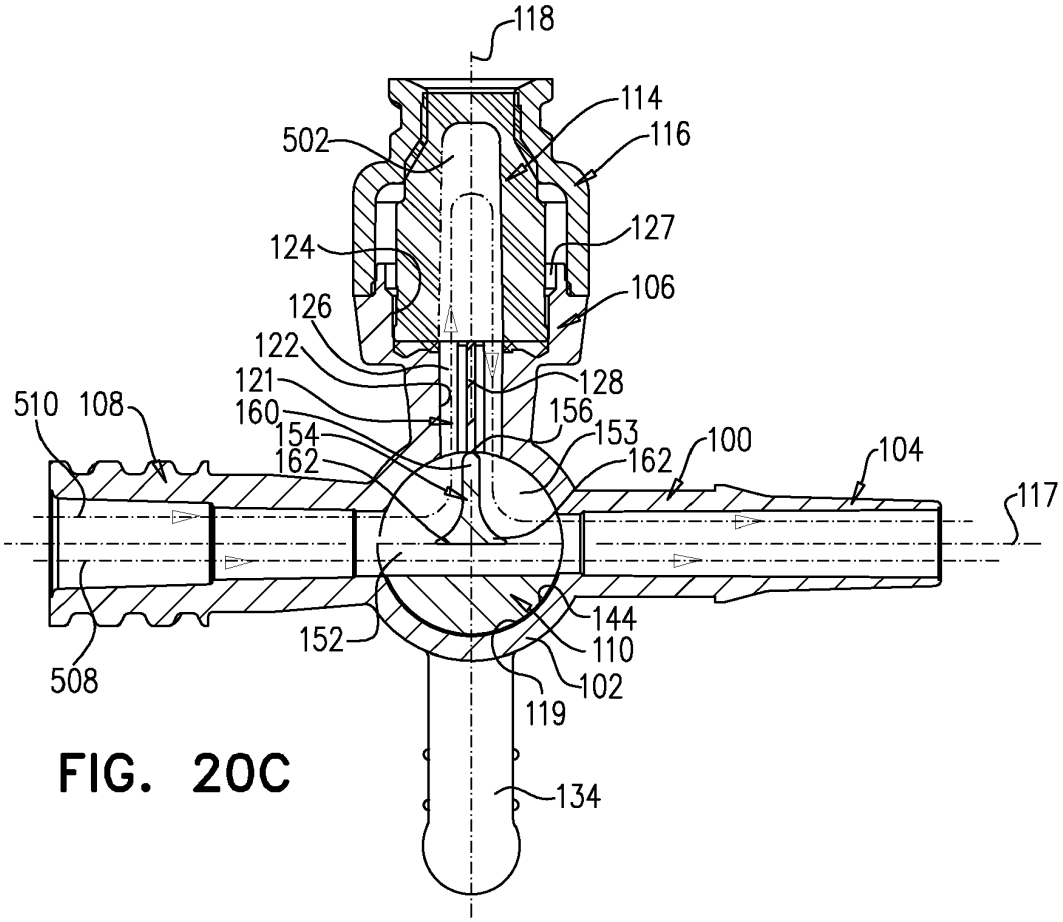


FIG. 20C

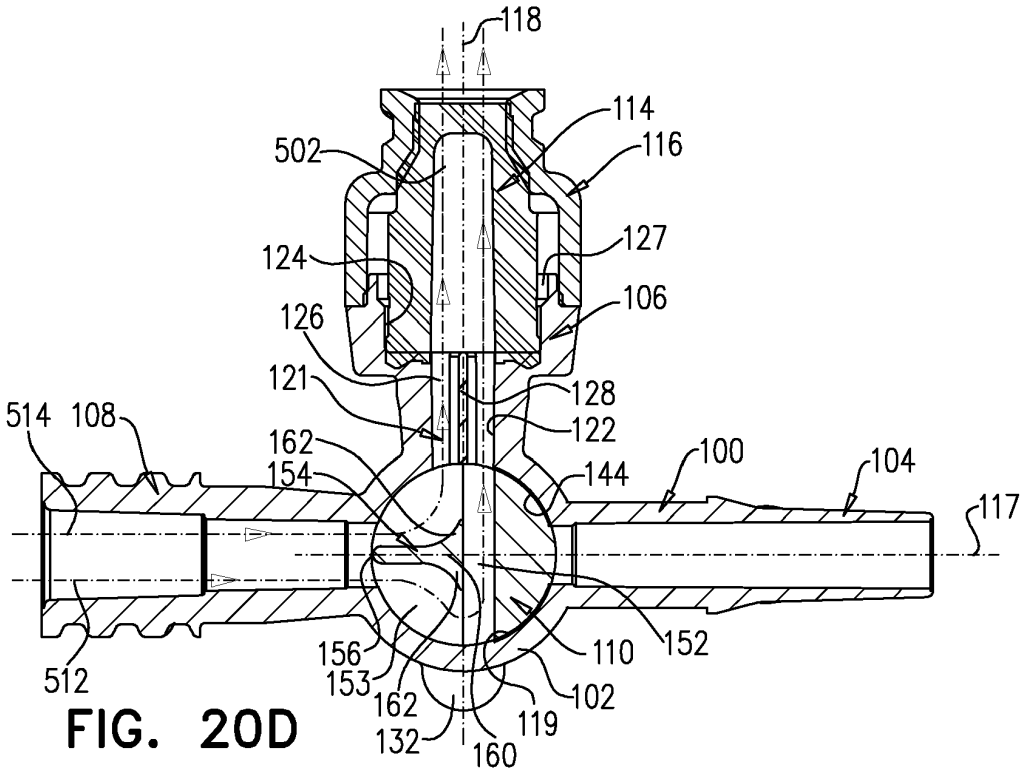


FIG. 20D

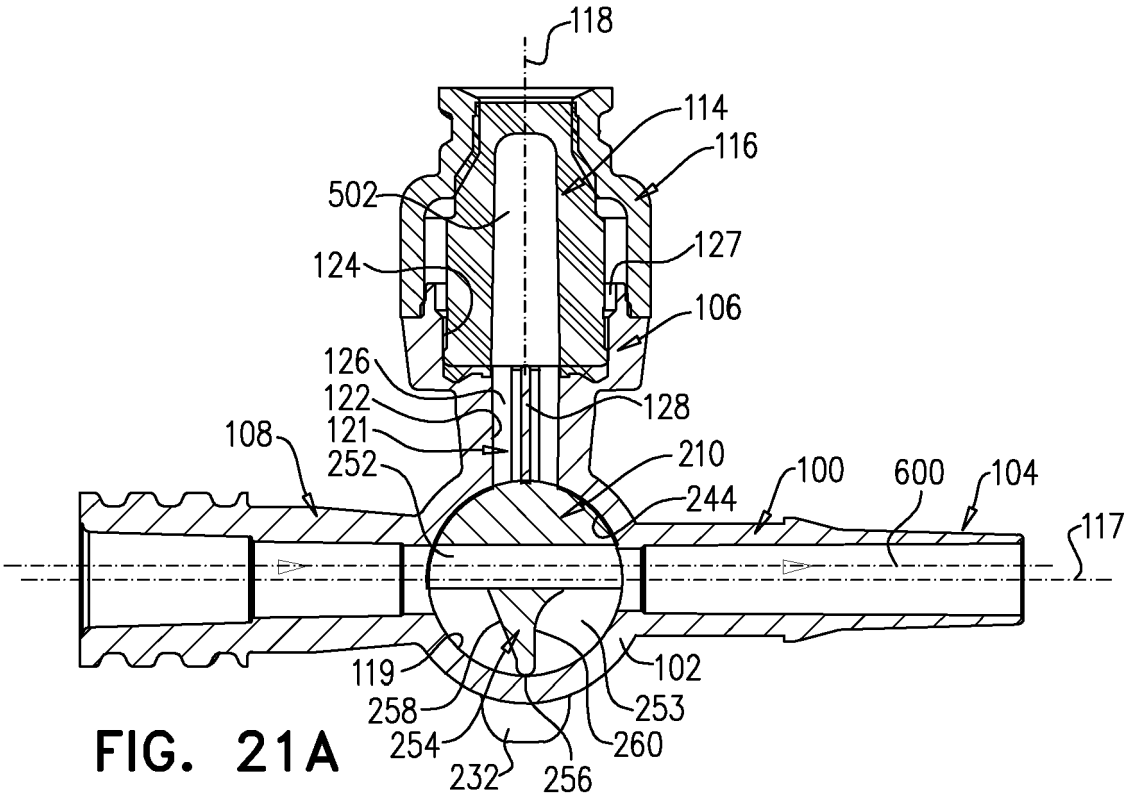


FIG. 21A

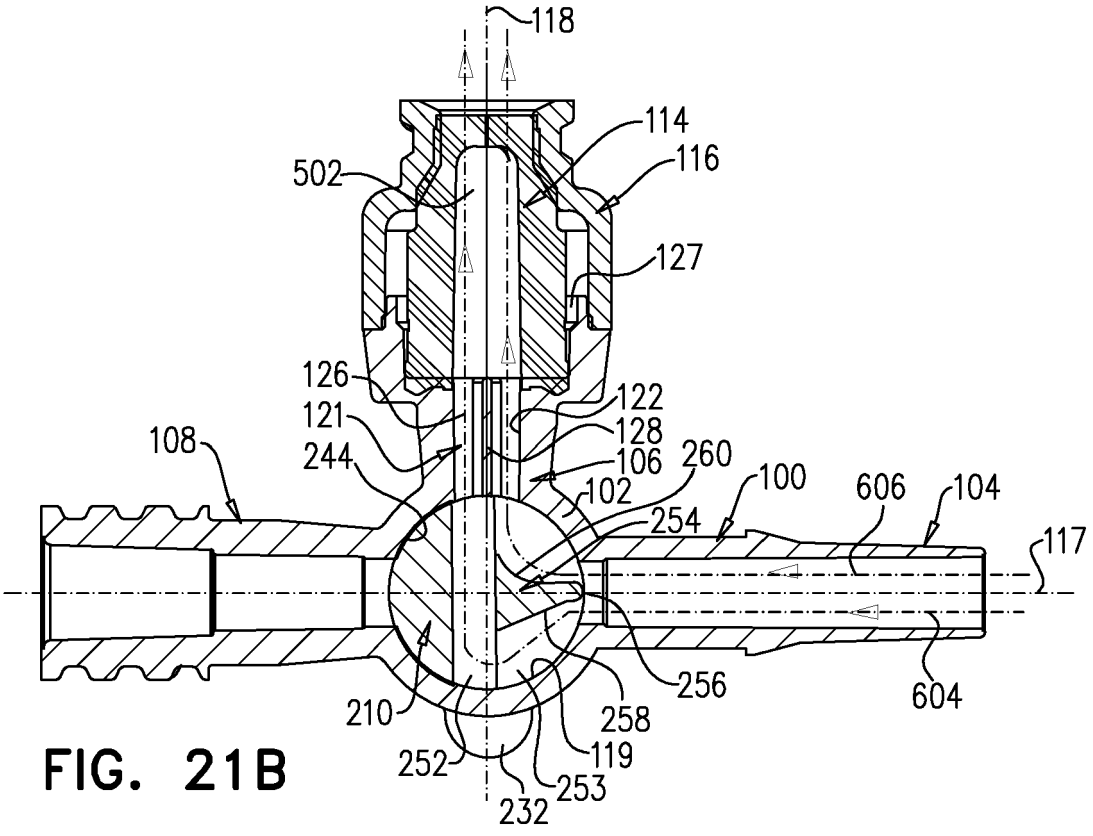


FIG. 21B

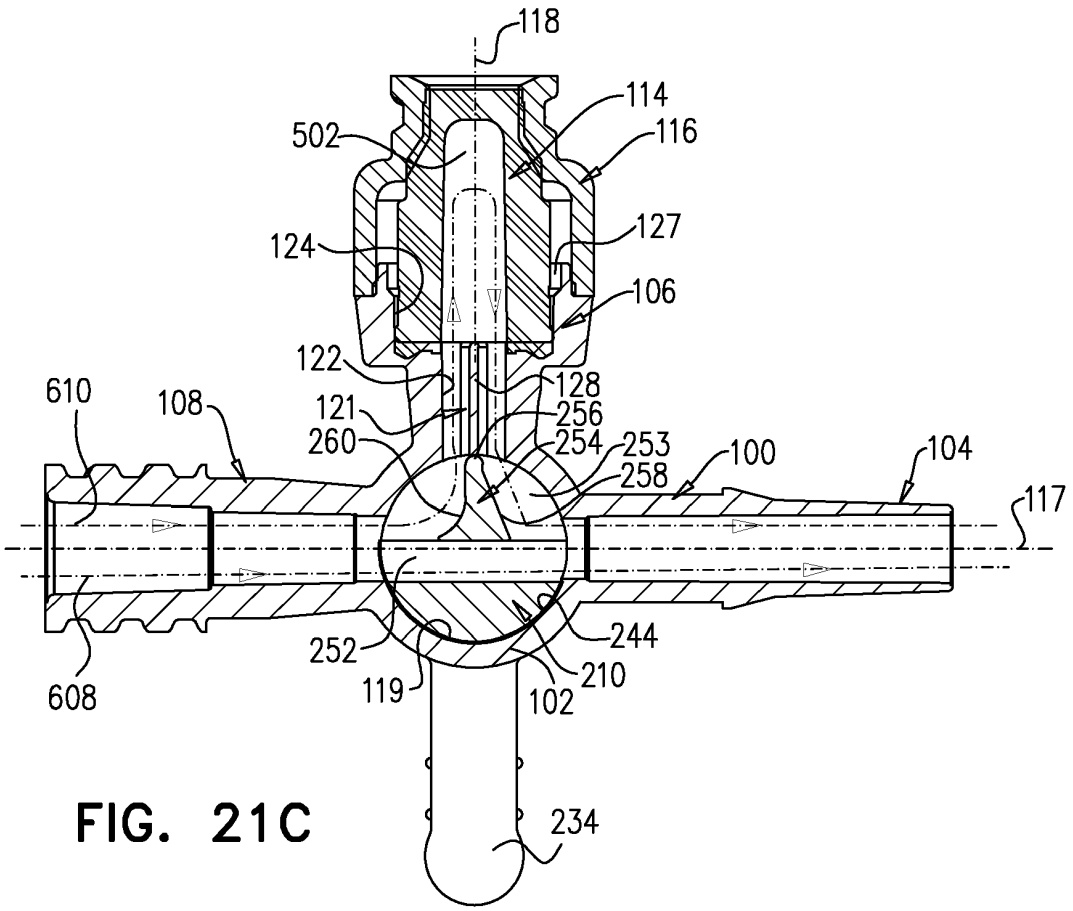


FIG. 21C

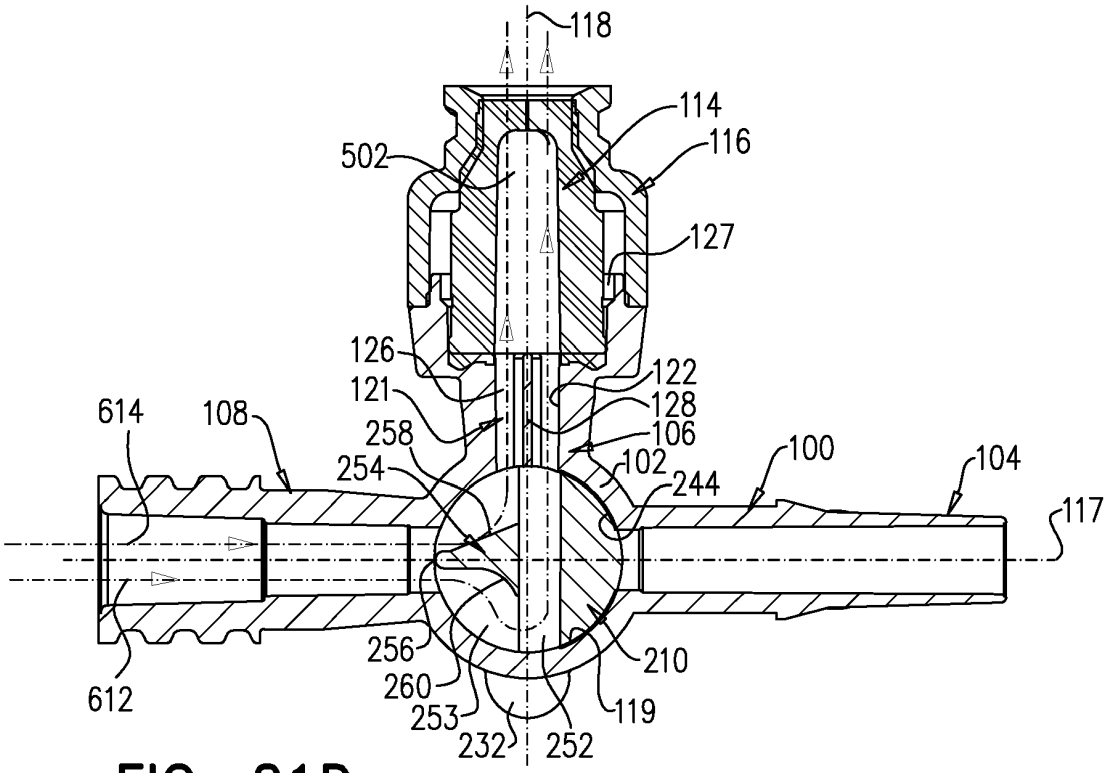


FIG. 21D

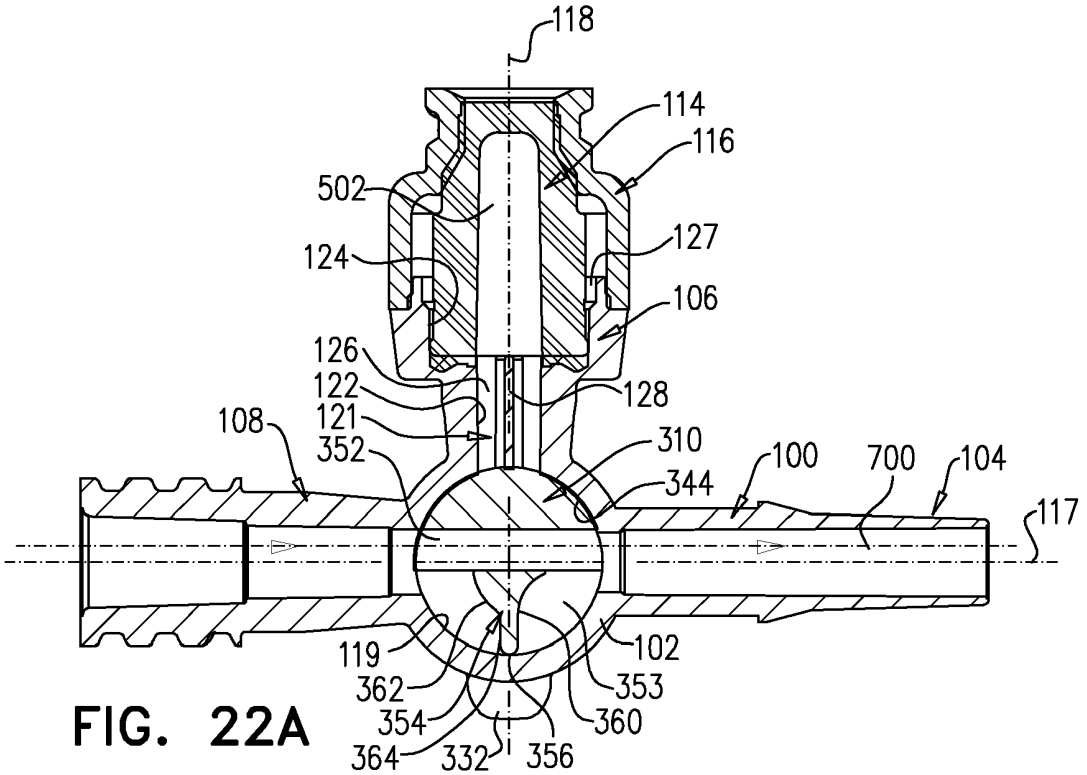


FIG. 22A

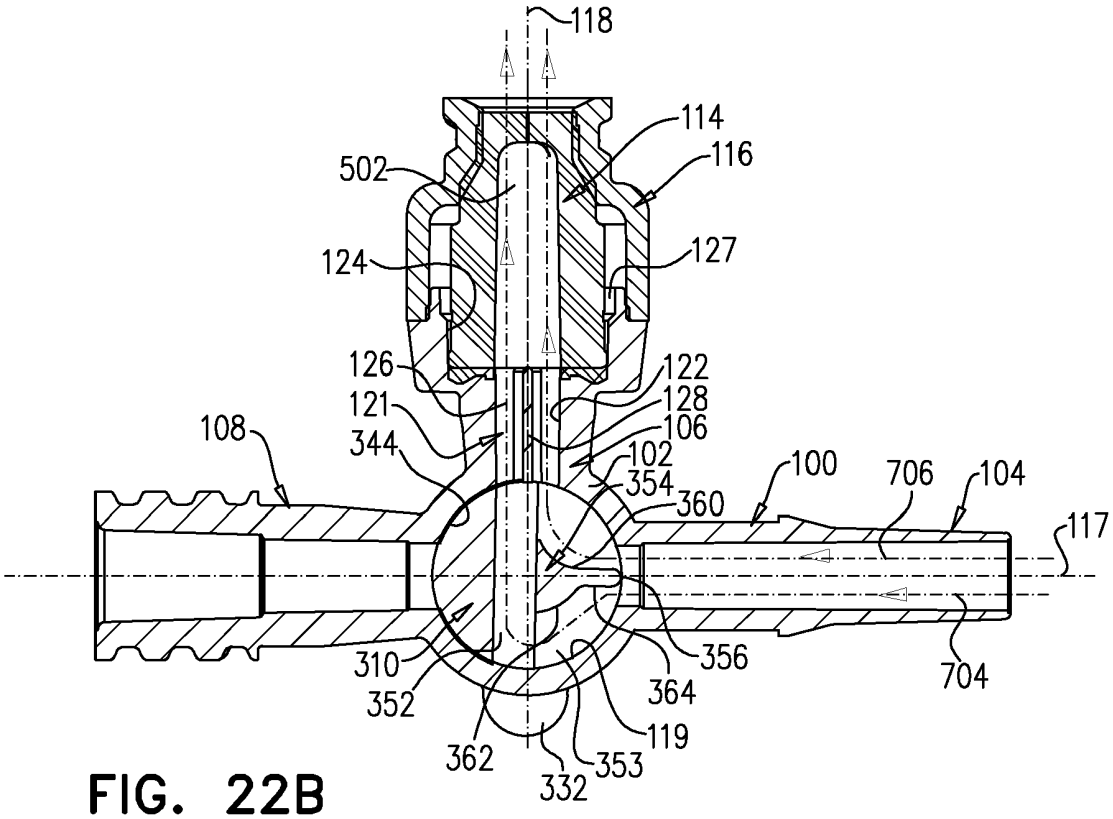


FIG. 22B

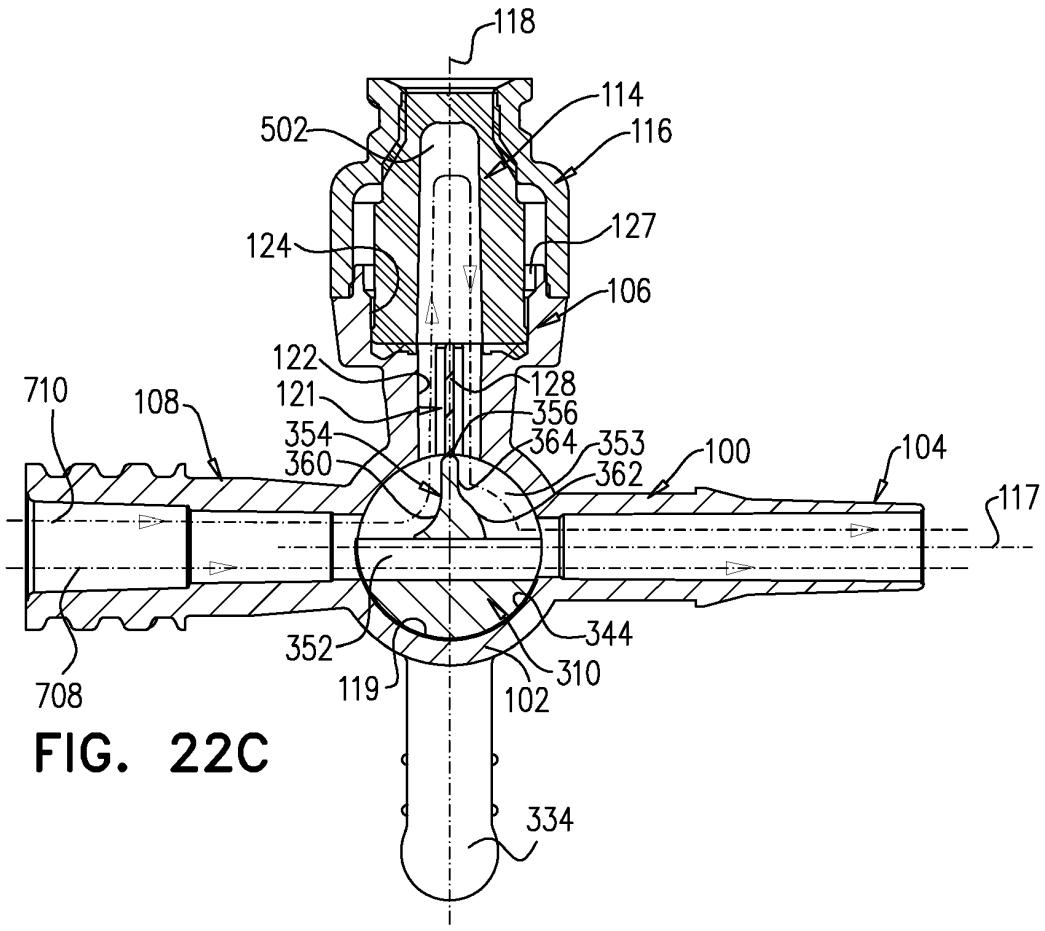


FIG. 22C

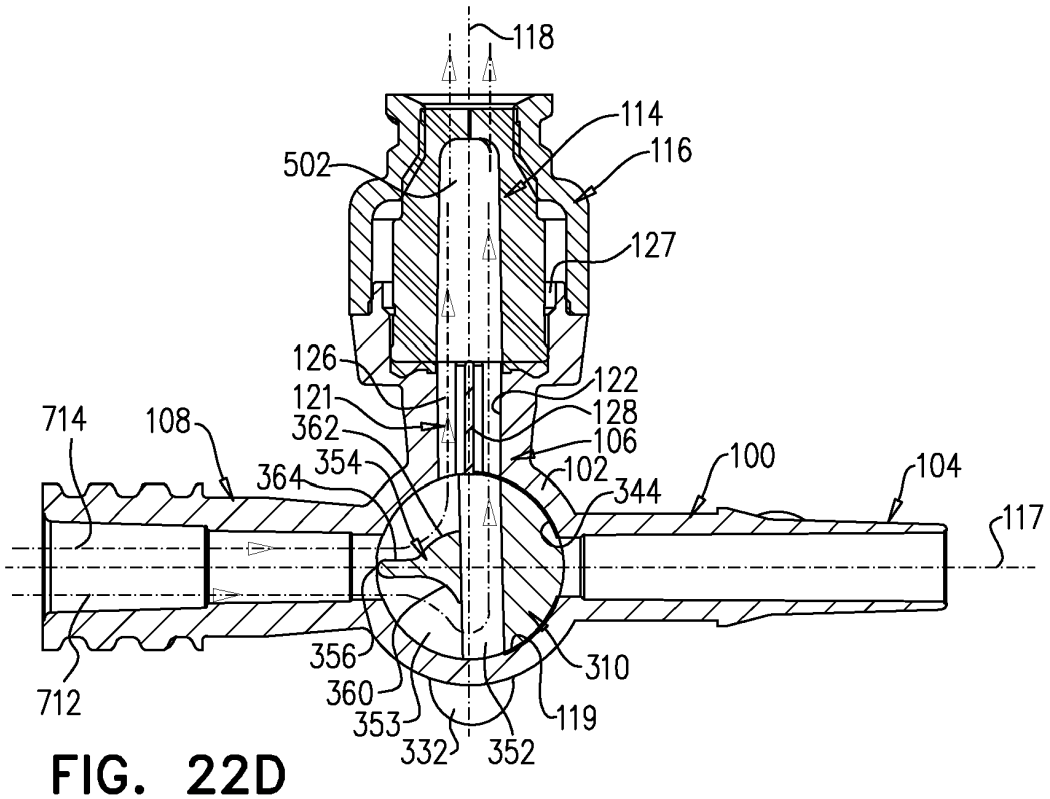


FIG. 22D

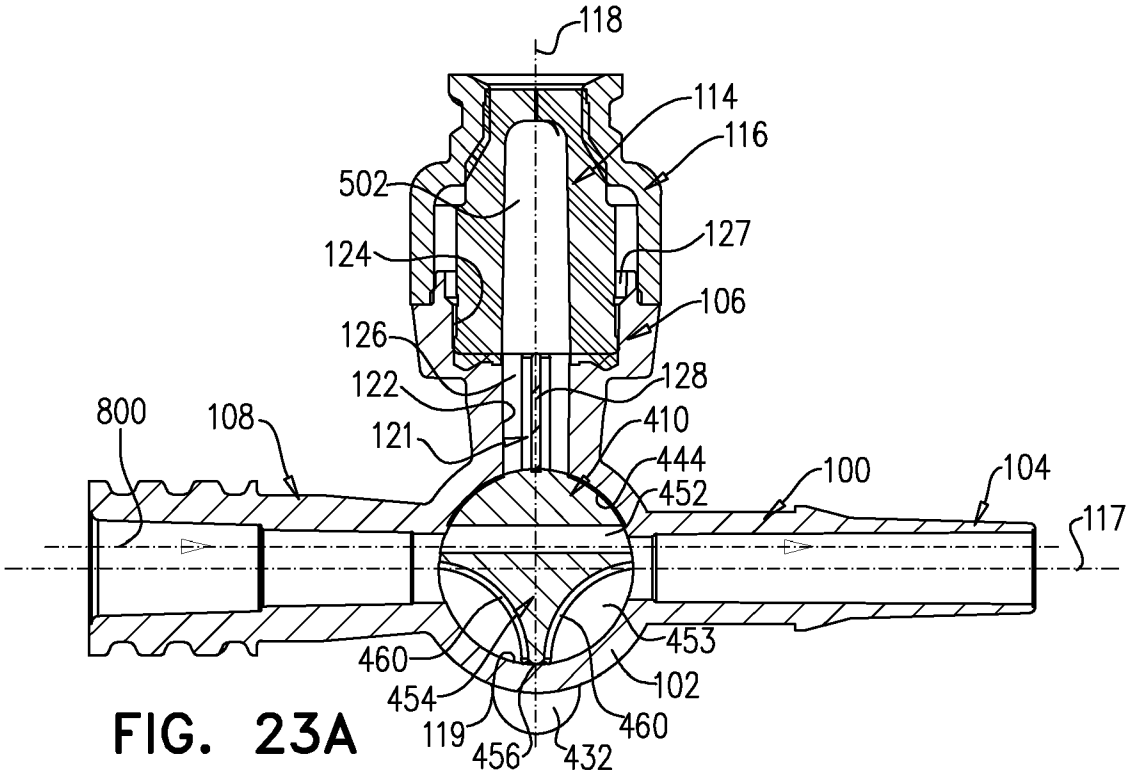


FIG. 23A

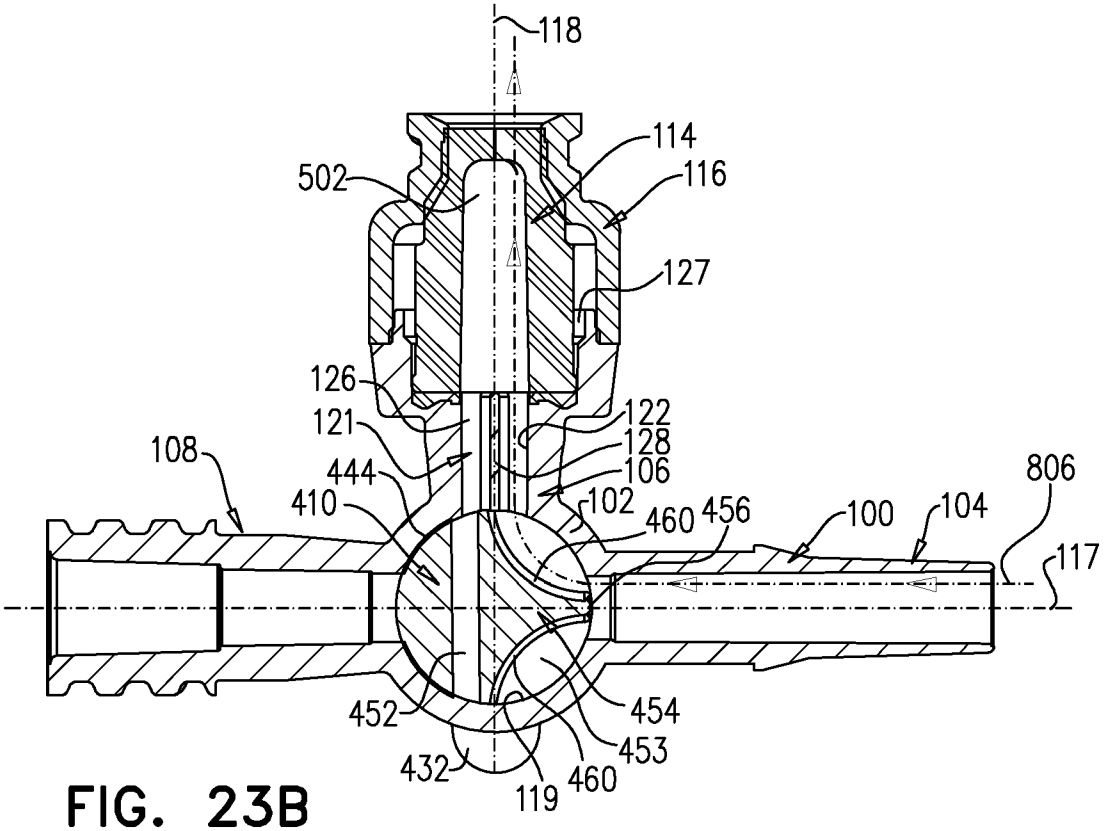


FIG. 23B

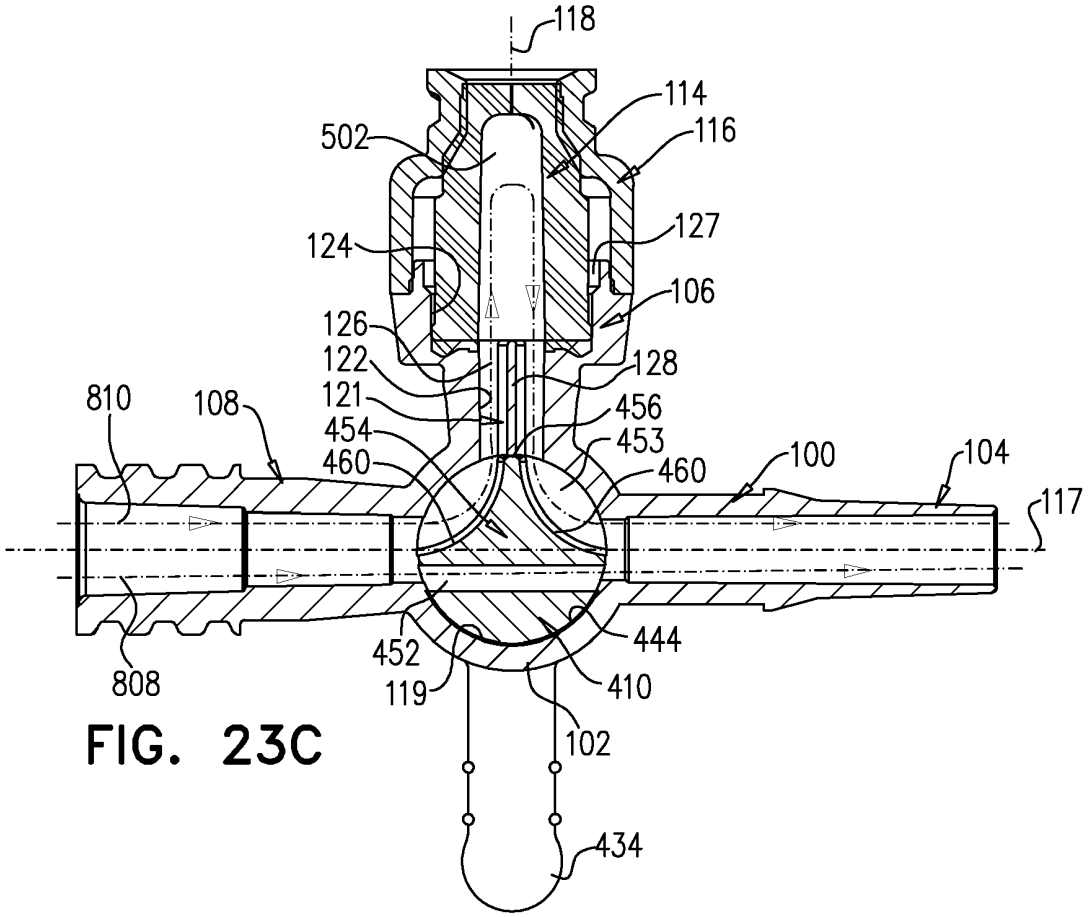


FIG. 23C

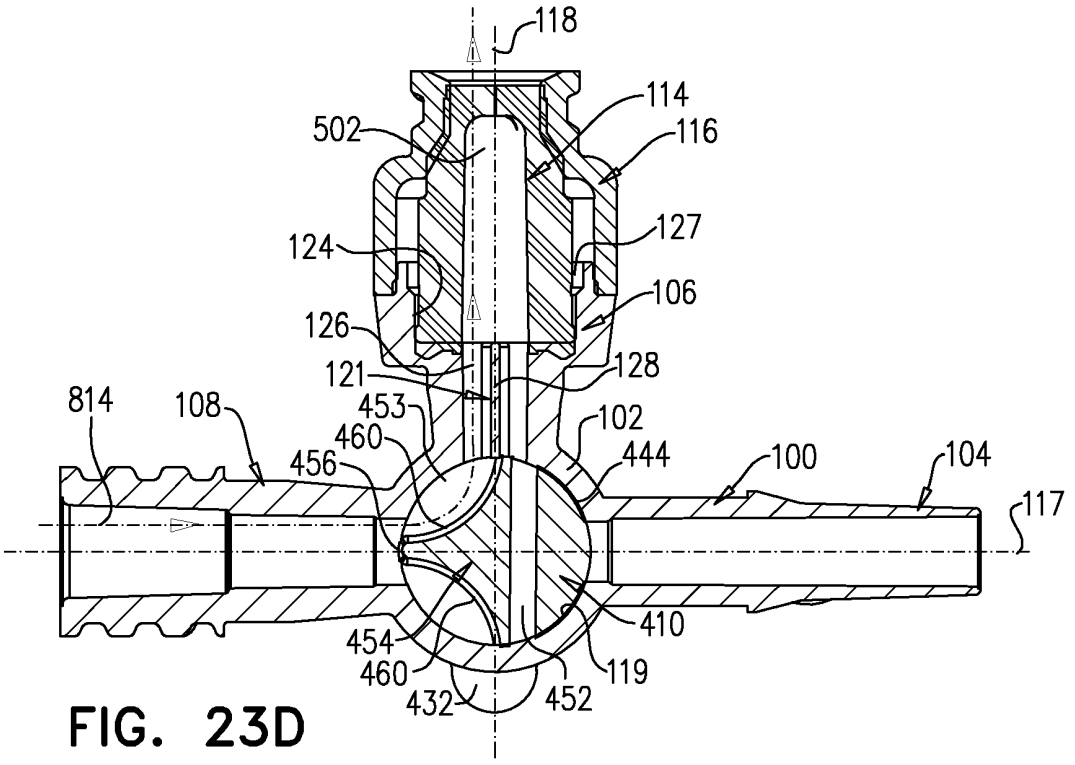


FIG. 23D

REFERENCES CITED IN THE DESCRIPTION

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